EFFECTIVENESS OF ERGONOMICS ON PHYSICAL DISCOMFORT AMONG COMPUTER USERS AT SELECTED IT OFFICE IN MADURAI

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CERTIFICATE

This is to certify that this dissertation titled**, "EFFECTIVENESS OF ERGONOMICS ON PHYSICAL DISCOMFORT AMONG COMPUTER USERS AT SELECTED IT OFFICE IN MADURAI"** is a bonafide work done by **Ms.THENNARASI.M,** M.Sc (N) Student, College of Nursing, Madurai Medical College, Madurai - 20, submitted to THE TAMILNADU DR.M.G.R. MEDICAL UNIVERSITY, CHENNAI in partial fulfillment of the university rules and regulations towards the award of the degree of **MASTER OF SCIENCE IN NURSING, BRANCH IV, COMMUNITY HEALTH NURSING,** under our guidance and supervision during the academic period from 2013—2015.

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ABSTRACT

Title: Effectiveness of ergonomics on physical discomfort among computer users at selected it office in Madurai. Objectives: To assess the level of physical discomforts among computer users in selected IT offices at Madurai; to evaluate the effectiveness of ergonomics among computer users in selected IT office at Madurai; to determine the association between the levels of physical discomfort with their selected socio demographic variables. **Hypothesis:** The Mean post test score is significantly lower than the mean pre test score of Physical discomforts among the computer users; there is a significant association between the levels of physical discomforts with their selected socio demographic variables. **Conceptual Framework:** Modified Daniel L. Stufflebeam. **CIPP** model. **Methodology:** Quantitative approach Pre Experimental - One group Pre test post test design was used. 40 subjects were selected in Great Minds Business Solution India Ltd IT office at Madurai by purposive sampling. After obtaining the informed consent from the subjects, pre test was conducted to assess the level of physical discomfort by using Rapid Upper Limb Assessment scale on first two days by observation method. Demonstration of Ergonomic intervention was given for 28 consecutive days. On the 29^{th} and 30^{th} day the post test was done. **Results**: The calculated 't' value (17.716) was much higher than the tabulated value at 0.001. There was no significant association between levels of physical discomfort and selected socio demographic variables of computer users. **Conclusion:** The study concluded that demonstration of ergonomic intervention was effective on reducing the levels of physical discomfort among computer users.

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Introduction

CHAPTER - I

INTRODUCTION

"Physical fitness is not only one of the most important keys to a healthy body, It is the basis of dynamic and Creative intellectual activity."

\- *John F. Kennedy*

Computers and information technology touch nearly every aspect of modern life. Information technology can help with such diverse tasks as driving motor vehicles and diagnosing diseases. Information technology enables seamless integration and communication between businesses anywhere in the world. To keep Information technology systems running, a large workforce is needed to maintain networks, create new software, and ensure information security. In addition, the proliferation of smart phones has given rise to a new "app economy," in which new employment opportunities are available for workers who create the programs that run on mobile devices. Unlike many other sectors of the economy, employment in the computer systems design and related services industry (commonly known as Information technology services) was not significantly affected by the recession of 2007–2009. The industry lost about 1 percent of its employment in 2009 but regained momentum in 2014, when it surpassed the employment numbers from 2008. The high demand for the services provided by this industry has created a large number of fast-growing and high-paying Information technology jobs.

For most of the past 20 years, employment in computer systems design and related services has grown rapidly. From 1990 to 2001, employment in the industry

arose quickly, as many businesses began to invest in computer systems. Between 2001 and 2011, employment in computer systems design and related services increased by 232,300 jobs or 18 percent. By 2014, employment had recovered and was higher than it had been in 2008.In Worldwide, about179,494,282 computers in the world, with perhaps an average of two people using each one, In United States has an estimated 223,810,000 personal computer users across the country, and the number has been going higher up in the recent times. Japan has led the digital revolution, after all. The approximate number of personal computer users in Japan is 62,000,000. According to china, estimates, there are about 52,990,000 users of personal computers in China. An estimated 389 million people surf the net in this Asian country. Germany has close to 45,000,000 people who use personal computers. There are almost 65.125 million internet users in the European country, which places it at the 5th position globally.

In India has estimated around 10 million Indians uses the computer. India is one of the fastest-growing Information technology services markets in the world. It is also the world's largest sourcing destination, accounting for approximately 52 per cent of the United States dollars of 124–130 billion market. The country's cost competitiveness in providing Information technology services continues to be in the global sourcing market.

India has the potential to build United States dollars of 100 billion computer product industry by 2025, according to Indian Software Product Industry Roundtable. The software products market in India, which includes accounting computer users, is expected to grow at 14 per cent in 2014.

Health and safety of the employees is an important aspect of a company's smooth and successful functioning. It is a decisive factor in organizational

effectiveness. It ensures an accident-free industrial environment. Companies must attach the same importance towards achieving high occupational health and safety performance as they do to the other key objectives of their business activities. Occupational health refers to the identification and control of the risks arising from physical, chemical, and other workplace hazards in order to establish and maintain a safe and healthy working environment.

Health is the level of functional or metabolic efficiency of a living organism. In humans, it is the general condition of a person's mind and body, usually meaning to be free from illness, injury or pain (as in good health).The World Health Organization defined health in its broader sense in 1946 as a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity. Although this definition has been subject to controversy, in particular as lacking operational value and because of the problem created by use of the word "complete," it remains the most enduring. Other definitions have been proposed, among which a recent definition that correlates health and personal satisfaction. Classification systems such as the World Health Organization's Family of International Classifications, including the International Classification of Functioning, Disability and Health and the International Classification of Diseases, are commonly used to define and measure the components of health.

Systematic activities to prevent or cure health problems and promote good health in humans are undertaken by health care providers. Applications with regard to animal health are covered by the veterinary sciences. The term healthy is also widely used in the context of many types of non-living organizations and their impacts for the benefit of humans, such as in the sense of healthy communities, healthy cities or healthy environments. In addition to health care interventions and a person's

surroundings, a number of other factors are known to influence the health status of individuals, including their background, lifestyle, and economic, social conditions, and spirituality; these are referred to as "determinants of health." Studies have shown that high levels of stress can affect the health of the individual.

An increasing number of studies and reports from different organizations and contexts examine the linkages between health and different factors, including lifestyles, environments, health care organization, and health policy. According to 1974 Lalonde report from Canada; the Alameda County Study in California; and the series of World Health Reports of the World Health Organization, which focuses on global health issues including access to health care and improving public health outcomes, especially in developing countries.

The concept of health field, as distinct from medical care, emerged from the Lalonde report from Canada. The report identified three interdependent fields as key determinants of an individual's health. These are: Lifestyle: the aggregation of personal decisions (i.e., over which the individual has control) that can be said to contribute to, or cause, illness or death; Environmental: all matters related to health external to the human body and over which the individual has little or no control; Biomedical: all aspects of health, physical and mental, developed within the human body as influenced by genetic make-up.

The maintenance and promotion of health is achieved through different combination of physical, mental, and social well-being, together sometimes referred to as the health triangle. The World Health Organization's 1986 Ottawa Charter for Health Promotion further stated that health is not just a state, but also a resource for everyday life, not the objective of living. Health is a positive concept emphasizing social and personal resources, as well as physical capacities.

Focusing more on lifestyle issues and their relationships with functional health, data from the Alameda County Study suggested that people can improve their health via exercise, enough sleep, maintaining a healthy body weight, limiting alcohol use, and avoiding smoking. The ability to adapt and to self manage has been suggested as core components of human health.

The environment is often cited as an important factor influencing the health status of individuals. This includes characteristics of the natural environment, the built environment, and the social environment. Factors such as clean water and air, adequate housing, and safe communities and roads all have been found to contribute to good health, especially to the health of infants and children. Some studies have shown that a lack of neighborhood recreational spaces including natural environment leads to lower levels of personal satisfaction and higher levels of obesity, linked to lower overall health and well being. This suggests that the positive health benefits of natural space in urban neighborhoods should be taken into account in public policy and land use.

Public health has been described as "the science and art of preventing disease, prolonging life and promoting health through the organized efforts and informed choices of society, organizations, public and private, communities and individuals." It is concerned with threats to the overall health of a community based on population health analysis. The population in question can be as small as a handful of people or as large as all the inhabitants of several continents (for instance, in the case of a pandemic). Public health has many sub-fields, but typically includes the interdisciplinary categories of epidemiology, biostatistics and health services. Environmental health, community health, behavioral health, and occupational health are also important areas of public health. The focus of public health interventions is to

prevent and manage diseases, injuries and other health conditions through surveillance of cases and the promotion of healthy behavior, communities, and (in aspects relevant to human health) environments. Its aim is to prevent health problems from happening or re-occurring by implementing educational programs, developing policies, administering services and conducting research.

As defined by the World Health Organization (WHO) "occupational health deals with all aspects of health and safety in the workplace and has a strong focus on primary prevention of hazards." Occupational health is a multidisciplinary field of healthcare concerned with enabling an individual to undertake their occupation, in the way that causes least harm to their health. For example, with the promotion of health and safety at work, this is concerned with preventing harm from any incidental hazards, arising in the workplace.

In addition to safety risks, many jobs also present risks of disease, illness and other long-term health problems. Among the most common occupational diseases are various forms of pneumoconiosis, including silicosis and coal worker's pneumoconiosis (black lung disease). Asthma is another respiratory illness that many workers are vulnerable to. Workers may also be vulnerable to skin diseases, including eczema, dermatitis, urticaria, sunburn, and skin cancer. Other occupational diseases of concern include carpal tunnel syndrome and lead poisoning.

As the number of service sector jobs has risen in developed countries, more and more jobs have become sedentary, presenting a different array of health problems than those associated with manufacturing and the primary sector. Contemporary problems such as the growing rate of obesity and issues relating to stress and overwork in many countries have further complicated the interaction between work and health.

Many governments view occupational health as a social challenge and have formed public organizations to ensure the health and safety of workers. Examples of these include the British Health and Safety Executive and in the United States, the National Institute for Occupational Safety and Health, which conducts research on occupational health and safety, and the Occupational Safety and Health Administration, which handles regulation and policy relating to worker safety and health.

Since 1950, the International Labour Organization and the World Health Organization have shared a common definition of occupational health. It was adopted by the Joint International Labour Organization / World Health Organization Committee on Occupational Health at its first session in 1950 and revised at its twelfth session in 1995. The definition reads, Occupational health should aim at: the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations; the prevention amongst workers of departures from health caused by their working conditions; the protection of workers in their employment from risks resulting from factors adverse to health; the placing and maintenance of the worker in an occupational environment adapted to his physiological and psychological capabilities; and, to summarize, the adaptation of work to man and of each man to his job.

The main focus in occupational health is on three different objectives, the maintenance and promotion of workers' health and working capacity, the improvement of working environment and work to become conducive to safety and health and development of work organizations and working cultures in a direction which supports health and safety at work and in doing so also promotes a positive social climate and smooth operation and may enhance productivity of the

undertakings. The concept of working culture is intended in this context to mean a reflection of the essential value systems adopted by the undertaking concerned. Such a culture is reflected in practice in the managerial systems, personnel policy, principles for participation, training policies and quality management of the undertaking.

Those in the field of occupational health come from a wide range of disciplines and professions including medicine, psychology, epidemiology, physiotherapy, ergonomics and rehabilitation, occupational therapy, occupational medicine, human factors and many others. Professionals advise on a broad range of occupational health matters. These include how to avoid particular pre-existing causing a problem in the occupation, correct posture for the work, frequency of rest breaks, preventative action that can be undertaken, and so forth.

Occupational hazards may include chemical agents and solvents, heavy metals such as lead and mercury, physical agents such as loud noise or vibration, and physical hazards such as electricity or dangerous machinery. . Occupational health problems occur at work or because of the kind of work you do. These problems can include, Cuts, broken bones, sprains, and strains, Loss of limbs, Repetitive motion disorders, Hearing problems caused by exposure to noise, Vision problems, Illness caused by breathing, touching, or swallowing unsafe substances, Illness caused by exposure to radiation, Exposure to germs in health care settings. Good job safety and prevention practices can reduce your risk of these problems. Try to stay fit, reduce stress, set up your work area properly, and use the right equipment and gear.

Maintaining a healthy working environment requires attention to chemical hazards, equipment and work station design, physical environment as (temperature, humidity, light, noise, ventilation, and space), task design, psychological factors like

(personal interactions, work pace, job control) and sometimes, chemical or other environmental exposures.

A well-designed office allows each employee to work comfortably without needing to over-reach, sit or stand too long, or use awkward postures. Sometimes, equipment or furniture changes are the best solution to allow employees to work comfortably. On other occasions, the equipment may be satisfactory but the task could be redesigned. For example, studies have shown that those working at computers have less discomfort with short, hourly breaks.

Situations in offices that can lead to injury or illness range from physical hazards (such as cords across walkways, leaving low drawers open, objects falling from overhead) to task-related (speed or repetition, duration, job control, etc.), environmental (chemical or biological sources) or design-related hazards (such as nonadjustable furniture or equipment). Job stress that results when the requirements of the job do not match the capabilities or resources of the worker may also result in illness.

Many of us would agree that in our lifetime, no innovation has had such a sweeping and drastic change in our working environment as the computer has. Since the invention of the computers in 1970s, their usage in modern society has risen experimentally and the demand for computer professionals in all aspect of industry is on a rapid rise

With a progressive emergence of this technology, the concerns have been raised about the possible adverse effects on the health of the users. This ranges from ordinary complaints like headache, eyestrains, neck/back strains to the increased effects of radiations on reproductive function and musculoskeletal disorders.

Minimizing the adverse effects of computer usage benefit not only in terms of decreased health complaints but also increases work productivity.

Computer, a hallmark of technological advancement has ushered in a new genre of the occupational health problem, i.e. of computer-related health problems. In today's world, using a computer is a necessity for the majority of people. But, few people actually consider the medical consequences from it. Working with computers for an extended period of time can cause damaged eyesight, bad posture, arthritis in fingers and computer stress injuries .The aforesaid problems are due to many factors such as poor component design, proximity of the user to the screen and an excess of consecutive working hours; which signifies that the above problems could be identified in computer users

As for portable personal computers, notebook computers known as laptop computers, there are some significant differences in the features but the same in function categories. They contain components that are similar to their desktop counterparts and perform the same functions. The advantages of notebook computers are miniaturized and optimized for upwardly mobile use and efficient power consumption (small size of batteries). Basically, notebook computer with a flat panel display and built-in keyboard attached with the screen, requiring a seated position and both hands relatively. Notebook computers were originally designed as portable temporary solution, compact computers for the traveler's computer, this compact design that adds to the potential for ergonomic risk with prolonged use. Unlike desktop computers, the monitor and keyboard independently can be adjusted to position the top of monitor around eye level, and place keyboard at about the same level as elbows. Notebooks have some inherent design features that make them a

potential ergonomic danger. Since the keyboard and the monitor are attached to each other, if the keyboard is in the correct position for the user, then the screen is not.

The computer is probably one of the most useful things ever invented by man. We use it in almost every aspect of life – personal, work, health care, transportation, entertainment, education, and even dating. We have come to rely on computers so much that we spend a lot of our time in front of them. Although they do make our lives a whole lot easier, prolonged use can present various health and physical hazards.

Revolution in information technology is happening worldwide with great pace. About 30% of the work force in developed and much more in the developing countries report with work related problems. Each year, 8% of working Dutch citizens takes time off from work due to Repetitive Strain Injuries symptoms, According to Canadian report 10% of Canadian young adults report with Repetitive Strain Injuries, Health problems in computer users appear to be interrelated, and they are musculoskeletal 'or' musculo-tendinous, visual and stress related. India is becoming a hub of information technology industry with large number of young people in it. One of the early studies on 200 subjects 3 revealed 40% - 50% of them suffer from fatigue, more than 40% musculoskeletal disorders predominantly from neck & upper limb. Recent studies have also revealed peculiar incidence of Sacroiliac joint pain and systemic disease like early diastolic hypertension among Indian professionals. We have been following information technology professionals (n = 14,300) past 7 years on occupational health status and it is felt that Indians (probably Asians) perceive differently to these work-related problems.

The prevalence of musculoskeletal disorders reported in the united states has increased steadily within the past decade, accounting for more than 65% of overall

occupational illnesses. Of 308,000 musculoskeletal disorders due to repeated trauma reported in the united states in 1995, a total of 92,576 injuries were due to typing or key entry, repetitive tool use, repetitive grasping, pushing, or moving objects other than tools. According to a conservative estimate by the National institute for occupational safety and health, work- related musculoskeletal disorders cost the united states industry more than thirteen billion dollars per year.

In cross-sectional study, Maeda et al used a questionnaire and body diagram to determine the prevalence of physical discomfort among computer operators in Japan. A total of 110 female computer operators, who were required to enter data with their right hand into a numeric keyboard, were compared to 57 sales women who had no exposure to a case register or other machines. Subjects rated symptoms of tiredness, pain and numbness for each part of their body, and certain aspects of their workstation were measured. The prevalence of pain and tiredness in the right and left hand were significantly higher (Mann-Whitney U test, $p<0.01$) among the computer operator than the saleswomen. For the computer operators, the mean table and keyboard heights were reported to be too high. For both groups, awkward work postures were qualitatively described.

Computer use is widespread in workplace and at home, with up to 25% of people reported to use a computer for more than 50% of their working day. Over the past decade there has been a rapid increase in computer use, with worldwide personal computer shipments doubling from 25 million in 1990 to 57 million in 1995. Worldwide, approximately 90 million adults use computers regularly. India has been in the forefront of the cyber world with IT industries developing into a major service provider. Among these, Bangalore has the highest number of software companies in India, hence called the Silicon Valley of India

According to the National Institute of Occupational Safety and Health, computer vision syndrome affects some 90% of the people who spend three hours or more a day at a computer. Around 25% of all computer users have carpel tunnel syndrome. The prevalence of cervicogenic headache caused by computer usage in general population is estimated to be 0.4% - 2.5% but is as high as 20% in patients with chronic headache.

A survey done in Oman to evaluate the ergonomics problems in computer workstation design shows that 45% of the employee used non adjustable chair and 48% of computers faced windows and 90% of the employees used computer more than 4 hours per day, 45.5% adopted bent unsupported back posture and 20% used office tables for computers, 58% reported eye strain, 45% reported shoulder pain, 43% back pain, 35% arm pain, 35% wrist pain and 30% reported neck pain respectively.

According to survey done in Mumbai to estimate the prevalence of computer related health problems among software professionals shows that the prevalence of any type of computer-related morbidity in software professionals was 178 (89%). The proportion of visual, musculoskeletal, and stress was found to be 67%, 63%, and 44%, respectively.

A survey was conducted to find the prevalence of work-related wrist and hand musculoskeletal disorders among computer users in Karnataka state. It shows that Prevalence of self-reported work related musculoskeletal disorders of the wrist and hand was 58%. Women were more to report symptoms than men (69% vs. 53%). Computer users between 21 to 30 years of age were more to report symptoms than those between 40 to 55 years (76% vs. 9 %).

Many computer users suffer from bad posture mainly because they forget to be conscious about the way they sit and position their body. You may experience stiffness in the neck and shoulders after sitting in the same position for a long time.

The stiffness can also be a result of wrong posture. Back pain can occur after long periods of sitting in front of the computer. The usual culprits are incorrect posture, inefficient workplace organization, and muscle tension due to stress. Back and neck pain, headaches, and shoulder and arm pain are common computer-related injuries. Such muscle and joint problems can be caused or made worse by poor workstation (desk) design, bad posture and sitting for long periods of time.

Apart from musculoskeletal symptoms, visual affection and psychological affection is seen in computer professionals who work for more than 6 hrs per day or 15 hrs per week. A survey done by the American Optometric Association estimates that at least 10 million cases of computer-related eyestrain were reported each year.

The human eye basically prefers to look at the objects greater than six meter away, thus work done on computer demands a close-up view which strains eye muscles and thereby leads to eye fatigue. Surveys of computer workers reveal that vision-related problems are the most frequently reported health-related problems, occurring in over 70% of computer workers. Computer vision syndrome is related to the unique aspects of the task.

Working at a computer is more visually demanding than doing other standard office work such as reading printed documents. Aspects of the design of the computer video display such as screen resolution and contrast, image refresh rates and flicker, and screen glare, as well as working distances and angles all may contribute to worker symptoms.

The proliferation of video display terminals, in the modern office setting has generated concern related to potential health hazards associated with their use. Using the wrong chair or just sitting improperly in front of a computer for long time can lead to chronic disabilities such as stiffness, headache and backache. Muscles and tendons can become inflamed due to greater periods of sitting on personal computers.

Work related musculoskeletal disorders can significantly affect the occupational functions of all performance areas since the upper body, neck, back and hand are vital parts of the body. Symptoms arising from underlying musculoskeletal disorders, which include pain, tingling, and numbness during use, are caused by neural compression, inflammation of the muscle-tendon unit, and vascular alteration. Carpal tunnel syndrome is a common example of an overuse injury associated with computer work.

Carpal Tunnel Syndrome is caused by the repeated or excessive movement of the muscles and nerves in the hands and wrists. There is a strong association between work-related tasks (such as typing and using of the mouse) and Carpal Tunnel Syndrome.

Since most investigations regarding neck pain and computer use are retrospective, it is difficult to estimate the number of new cases of neck pain ascribed to computer use. More data is available on the general population. The one year incidence of neck pain in the 18–75 year old general population of the United Kingdom has been reported as 17.9% (95% CI 16.0–19.7). For cases not due to whiplash associated disorders, Hogg-Johnson et al, have summarized the incidence based upon a best evidence synthesis and report incidence rates in the general population ranging from 15.5–213 per 1000 person years. The incidence of work related neck pain in computer users ranges from 23.5% for a six month incidence to

an annual incidence of 34.4% (95% , 25.5–41.3). In a most recent systematic review, office workers and computer users experienced the highest incidence of neck pain of all workers with reported incidences ranging from 36 to 57.5 per 100 worker years.

Posture is an independent risk factor of modest magnitude for musculoskeletal disorders among computer users. It appears that lowering the height of keyboard to or below the height of the elbow and resting the arms on the desk surface or chair arm rests is associated with reduced risks of neck and shoulder musculoskeletal disorders.

Use of keyboards has been reported to be an important risk factor for neck and upper limb pain in many occupational surveys. A survey was done in which a regular occupational use of keyboard was associated with an increase prevalence of pain in the upper limb, particularly in the wrist or hand and at the shoulder.

“Ergonomics in back pain” found that poor awkward postures cause fatigue, strain and eventually pain. Poor postures may result in structural deformation of body, muscle contractures, pain in the back and legs, decreased lung capacities, poor circulation, intravascular pressures, kinks in the bowel and many irregularities.

Muscle needs stimulation to grow, they need to experience movement and maintain co-ordination. Good circulation also provides nutrition to muscles and joints, but they will be deprived of that if people stay in same position all day. Prolong sitting leads to a slackening of abdominal muscles and curvature of the spine which in turn is bad for the organs of digestion and breathing.

Unnatural postures and bad sitting can speed up the deterioration of the discs. Concentrating on the screen for long period could reduce the blink rate and allow the tear film on the surface of the eye to dry which can result into dry and sore eyes. Headaches result from several things that occur with computer work like screen glare and poor image quality.

Looking down on the low monitor pitches the head forward, placing strain on the neck muscles which in turn spasm. The spasm aggravates pressure on the nerve that emanates from beneath the seventh vertebrum of the cervical spine from the C8 nerve root area which is connected to the median nerve. This eventually causes the symptoms associated with carpal tunnel syndrome.

Various nomenclatures has been used to label and characterize such disorders like Repetitive Strain Injury, Occupational Overuse Syndrome, Occupational Cervicobrachial Disorder, Cumulative Trauma Disorder, Work Related Musculoskeletal Disorders, Complaints of arm, neck and shoulders. According to International Classification of Disability, the medical code for Repetitive Strain Injury is International Classification of Disability-9.

According to dictionary.com, Erg-go-nomic is the applied science of equipment design intended to maximize productivity by reducing operator fatigue and discomfort.

Klenine et al., 2009 done Ergonomics studies have often examined the muscle load in healthy pain free subjects and assumed that higher levels of muscle activity during work represented higher risks for developing musculoskeletal discomfort. Reports shown that the likelihood of pupils or staff suffering health problems linked to computer use is related to the amount of time spent using them and also lack of knowledge related to computer ergonomics. There is evidence that these health problems can be reduced through ergonomic approach and education.

We are only at the tip of the iceberg .An ounce of prevention is worthy of a pound of cure in order to avoid the pain, aches and disorders that millions of people suffer as a result of “Computer Burnout” Hence it is very important that health and safety issues need to be addressed. Even though this is a silent global epidemic, the

truth is that it is not being acknowledged. Most companies blindly follow ergonomics recommended by American or European countries, ignoring that the body stature are different across the world. Studies done by regarding the development of Anthropometric data for India male population of age group 18 – 60 indicate that in India male population in statistical terms are shorter eight centimeters compared to many European Industrial or Manufacturing nations. Moreover review of literature reveals that most of the studies on computer users are done in developed countries, very few are done in India. Therefore the present study was an attempt to fulfill this gap by making an investigation in this area in India.

Most people can ride any bicycle on flat ground for a short distance with no problem. On a fifty mile ride over hilly terrain, however minor adjustments in seat height, handle, bar angle, and the like can make the difference between top performance and severe pain. Similarly occasional computer users may notice no ill effects from poorly designed or badly adjusted work stations but those who spend hours a day for many years should pay careful attention to ergonomics.

As computer and internet use become increasingly widespread, large percentages of the population will enjoy the potential benefits and get exposed to health risks. The important question is whether there is a need for an Ergonomics "Healthy tips associated to computer use" to improve the level of knowledge and practice of the subjects.

1.1 NEED FOR THE STUDY

In 2015 the worldwide sales of Computers are projected to reach almost 517M units—up from 372M Personal Computer in 2011. It had taken 27 years to reach one billion computers in use and market researchers say it will take only 5 years to reach the next billion. The movement of body and limbs is inescapable in human-computer interaction. Whether browsing the web or intensively entering and editing text in a document, our arms, wrists, and fingers are at work on the keyboard, mouse, and desktop. These continuous movements cause Repetitive Strain Injury. Reports of studies have suggested clearly the likelihood of pupils or staff suffering health problems linked to computer use is related to the amount of time spent using them and also lack of knowledge related to computer ergonomics.

In the twenty-first century, computers have become almost as ubiquitous as the humble pen and paper in many peoples' daily life. There are approximately six computers per thousand populations with an installation of 18 million personal computers and their number is increasing all the time. Now a day’s computer has become one of the important parts of human being everyday work. We cannot imagine our life without computers and the fact is that they have become so important that nothing can replace them.

The proliferation of video display terminals, in the modern office setting has generated concern related to potential health hazards associated with their use. The computer is a vital tool in every dimension of work. However, the long periods of working at a computer can cause musculoskeletal problems, eyestrain, and overuse injuries of the hands and wrists which can be reduced or eliminated by proper workstation design and improved posture. In 2009, an online survey among software

engineers of South India found that, musculoskeletal discomfort was experienced by 75.5% respondents and computer vision by 59.4% of subjects in the past 12 months.

Survey among computer workers of America in 2001 revealed that, vision-related problems are the most frequently reported health- related problems, occurring in over 70% of computer workers.

A study conducted in Denmark among 2146 technical assistants to assess the musculoskeletal pain showed that in majority of subjects, the pain was aggravated and exacerbated by the use of computer peripherals like the mouse and keyboard.

A cross-sectional survey done among 200 computer users in IT companies of Mangalore, Manipal and Bangalore to investigate the awareness of Computer-Related Injuries in computer users, and their health behaviors related to computer use using a questionnaire, found that 58.5% were aware of Computer Related Injuries. The major causes of Computer related injuries identified were, keyboard use (40%), mouse use (33%) and striking keys hard (22%), 69% participants were aware that Computer Related Injuries is preventable. The study recommended that education programs on the appropriate health behaviors, cautious use of computers for leisure, and encouraged an active lifestyle for effective prevention of Computer Related Injuries.

The Bureau of Labor Statistics of the Department of Labor showed the incidence report of musculoskeletal disorders as musculoskeletal system and connective tissue diseases and disorders when the event or exposure leading to the case is bodily reaction (e.g., typing, prolong use of computer in sitting), overexertion, or repetitive motion. musculoskeletal disorders due to prolong computer use lead to,Sprains, strains, and tears, Back pain, Carpal tunnel syndrome.

Musculoskeletal disorders are associated with high costs to employers such as absenteeism, lost productivity, and increased health care, disability, and worker's

compensation costs. musculoskeletal disorders cases are more severe than the average nonfatal injury or illness.

In 2001, musculoskeletal disorders involved a median of 8 days away from work compared with 6 days for all nonfatal injury and illness cases. Three age groups (25–34 year olds, 35–44 year olds, and 45–54 year olds) accounted for 79% of case. Computer Operators, computer users, occupations accounted for 58% of the Musculoskeletal disorders (MSD) cases. Musculoskeletal disorders account for nearly 70 million physician office visits in the United States annually, and an estimated 130 million total health care encounters including outpatient, hospital, and emergency room visit.

In 2010, nearly 1 million people took time away from work to treat and recover from work-related musculoskeletal pain or impairment of function in the low back or upper extremities

The Institute in Medicine estimates the economic burden of musculoskeletal disorders s as measured by compensation costs, lost wages, and lost productivity, are between $45 and $54 billion annually.

The National Institute of Occupational Safety and Health reports that by the year 2011 one half of all office workers may suffer symptoms of repetitive / cumulative trauma disorders. If the incidences should rise as National Institute of Occupational Safety and Health predicts- 50% of all office workers will be averaging a repetitive / cumulative trauma disorders cost of $2,000 each.

Injuries resulting from repeated motion are growing. According to recent annual statistics from the United States. Survey of Occupational Injuries and Illnesses, over 302,000 Carpel Tunnel Syndromes account for nearly two-thirds all of workplace-related illnesses.

Ergonomic disorders are the fastest growing category of work-related illness. According to the most recent statistics from the United States Bureau of Labor Statistics, they account for 56 percent of illnesses reported to the Occupational Safety and Health Administration. Employers spend more than 7.4 billion in workers compensation costs, and untold billions on medical treatment, litigation costs, hidden costs and lost productivity. Examples of common musculoskeletal disorders are discussed below.

The United Status Department of Labor defines Carpal tunnel syndrome as a disorder associated with the peripheral nervous system, which includes nerves and ganglia located outside the spinal cord and brain. Carpal tunnel syndrome is the compression of the median nerve at the wrist, which may result in numbness, tingling, weakness, or muscle atrophy in the hand and fingers. Carpel tunnel syndrome may affect as many as 1.9 million people, and 300,000 to 500,000 surgeries are performed each year to correct this condition. The Bureau of Labor Statistics reported 26,794 Carpal tunnel syndrome cases involving days away from work in 2012, representing a median of 25 days away from work compared with 6 days for all nonfatal injury and illness cases. Most cases involved workers who were aged 25–54 (84%), female. Two occupational groups accounted for more than 70% of all Carpal tunnel syndrome cases in 2013: operators, computer with keyboard users, fabricators, and laborers; and technical, sales, and administrative supporters. Currently, Carpal Tunnel Syndrome affects over 8-million people in the world. Presently, 50% of all computer operators have Carpal Tunnel Syndrome, with estimates that by the year 2013. Surgery for carpal tunnel syndrome is the second most common type of musculoskeletal surgery, with well over 230,000 procedures performed annually.

If computer users type 40 words a minute, they press 12,000 keys per hour or 96,000 keys per 8-hour day. Approximately 8 ounces of force is necessary to depress one key. Almost 16 tons of force will be exercised by your fingers.

Repetitive typing and key entry is highly associated with missing work due to carpal tunnel syndrome. The risk for carpal tunnel syndrome in this group, however, is still much lower than with occupations involving heavy labor. One small 2001 study reported that nerve conduction tests on frequent computer users showed the same rate of carpal tunnel syndrome (3.5%) as in the general population. However, 10% of the computer users complained of carpal tunnel syndrome symptoms and 30% reported tingling and burning in the hand. The typing speed may affect risk. For example, the fingers of typists whose speed is 60 words per minute exert up to 25 tons of pressure each day. And in one, study typists with carpal tunnel syndrome struck the keys with greater force than those without the disorder did.

Back symptoms are among the top ten reasons for medical visits. For 5% to 10% of patients, the back pain becomes chronic. In 2012, the Bureau of Labor Statistics reported 372,683 back injury cases involving days away from work. Most cases involved workers who were aged 25–54 (79%), male (64%), and white, two occupational groups accounted for more than 54% of back injury cases: computer users, fabricators, and laborers (38%); and precision production, craft, and repair (17%).

In India, A Study is conducted regarding Visual and Musculoskeletal Health Disorders among Computer Professionals in National Capital Region Delhi. The report showed that nearly three fourths of the computer professionals to have some computer-related health problems. This is a significant proportion and denotes that the occupational health of the people working in the computer field should be emphasized

as a field of concern in public health. The ergonomics of the working environment of the computer professionals have a direct impact on their well being. Hence the organizations employing them, as well as the professionals themselves need to be sensitized regarding the importance of the regular health checkups and proper working conditions.

The Hindu Sunday magazine published on 23 august 2005, they published the Hidden hazards for computer users Computer-related injuries that began to be reported in India five years ago are now developing into an epidemic among computer users. Health problems related to excessive use of computers are much more common than one may think, says S. Maheshkumar, orthopedic consultant at the General Hospital here. Delivering a lecture on the health hazards caused by computers at the Institution of Engineers here, Dr. Maheshkumar pointed out that worldwide, 25 per cent of computer users had computer-related injuries, caused by bad ergonomics at the workplace and because of wrong methods of using the keyboard. He said it had now been proven that the duration of work hours and computer-related problems had a correlation. Repetitive strain injuries caused by repeated physical movements, which damaged the tendons, nerves muscles and other soft body tissues, were the most commonly reported problem among computer users. The use of flat, feather-touch keyboards, which permitted high-speed typing, thousands of repeated keystrokes and long periods clutching and dragging the mouse, are responsible for causing Repetitive strain injuries in computer users

The Hindu Sunday Magazine published on 23 March 2013that too much time at the computer can leave one vulnerable to a host of ailments. They given some ergonomic tips such as, Prolonged working hours, wrong sitting posture and constant keyboard use leads not only to strain in the eyes but also to severe nerve and bone

injuries. Motion is the lotion for the joints. Movement and activity circulate joint fluid and promotes cartilage health and bone strength. Sitting for more than four hours daily combined with poor posture can lead to degenerative joints, which affects knees, hips and spine. Similarly working on a computer for hours together can cause inflammation of tendons, nerve sheaths and ligaments and damage to soft body tissues. Though this depends on the individual's sensitivity to the repeated movements involved in a particular activity the effects can even be disabling. One of the major nerve injuries caused due to excessive computer use is repetitive strain injury (a stressed limb caused by a repeated movement done the wrong way). One example is pain in the wrist because of excess keyboard use. Tendinitis and Carpal tunnel syndrome are other major problems caused by excessive strain on the nerves. Moreover, working with a light screen background with dark typefaces is easiest on the eyes. It is great to take breaks by looking away from the screen for ten seconds and standing up every half an hour to do other work while giving the eyes a rest.

In Tamilnadu, A cross-sectional study was conducted among medical and engineering college students of a University situated in the suburban area .Students who used computer in the month preceding the date of study were included in the study. The participants were surveyed using pre-tested structured questionnaire. The result showed among engineering students, the prevalence of Carpal Tunnel Syndrome was found to be 81.9% (176/215) while among medical students; it was found to be 78.6% (158/201). A significantly higher proportion of engineering students 40.9% (88/215) used computers for 4-6 h/day as compared to medical students 10% (20/201) ($P < 0.001$). The reported symptoms of Carpal Tunnel Syndrome were higher among engineering students compared with medical students. Students who used computer for 4-6 h were at significantly higher risk of developing

redness (OR = 1.2, 95% CI = 1.0-3.1,*P*= 0.04), burning sensation (OR = 2.1,95% CI = 1.3-3.1, $P < 0.01$) and dry eyes (OR = 1.8, 95% CI = 1.1-2.9, $P = 0.02$) compared to those who used computer for less than 4 h. Significant correlation was found between increased hours of computer use and the symptoms redness, burning sensation, blurred vision and dry eyes.

The computer operators and information technology professionals face a tough time tackling the occupational health problems. Ocular discomfort, musculoskeletal disorders and psycho-social problems form the key categories of health problems found among constant computer users. These problems require a multidisciplinary action. Health education and training of personnel could form the back bone of the cure. Application of ergonomics and better technology are also essential. There is an immediate need to sensitize the management of the organizations employing computer professionals, about these problems and enforce suitable measures to prevent the burn out of the employees.

Prolonged visual display terminal operation is a leading cause of musculoskeletal disorders and cumulative trauma disorders such as low back pain, carpal tunnel syndrome, stiff shoulders, and sore neck among office employees. The problems are intensified by awkward work posture, e.g., bent neck, bent wrists, or excessively flexed forearms. Numerous research studies were conducted to give recommendations about visual display terminal operation and seated posture, resulting in the hierarchical file system 100-1988 Standard (Hierarchical File System, 1988).

Mekhora et al. (2000) reported that neck and shoulder pain is prevalent in office employees especially those who work with computers. Rurkhamet and Nanthavanij (2004) developed an analytical design method for computing workstation settings and positioning computer accessories so as to help computer users sit with a

correct posture. Later, Rurkhamet and Nanthavanij (2004a) developed, a rule-based decision support system, based on their analytical algorithm

Ergonomics is the applied science of equipment design, as for the workplace, intended to maximize productivity by reducing operator fatigue and discomfort. The word ergonomics is derived from the Greek words ergos and nomos. Ergos means work and nomos meaning law is the laws of work. When ergonomics is applied correctly in the work environment, visual and musculoskeletal discomfort and fatigue are reduced significantly. Ergonomic exercise is one of the most effective ways of reducing muscle fatigue and the possibility of injury occurrence when using the computer. Ergonomic exercises prepare our body for our next period of work, and Micro-breaks keep the body loose while using the computer.

The goal of ergonomics is to reduce stress and eliminate injuries and disorders associated with the overuse of muscles, bad posture, and repeated tasks. A workplace ergonomics program can aim to prevent or control injuries and illnesses by eliminating or reducing worker exposure to work related musculoskeletal disorders risk factors using engineering and computer users. Risk factors include awkward postures, repetition, material handling, force, mechanical compression, vibration, temperature extremes, glare, inadequate lighting, and duration of exposure.

Ergonomic research suggests that computer workstations which promote awkward or constrained work postures predispose users towards musculoskeletal injuries, and that persistent musculoskeletal problems relate to poor workstation design and adjustability (Harbison & Forrester, 1995). Adjustable workstations are generally recommended for proper seating during computer operation so as to minimize discomfort. At least, the workstation should allow the keyboard and monitor to be adjusted independently. Unfortunately, due to its hinge design, the heights of

National Broadcasting Company's computer base and screen units cannot be adjusted independently. This design could lead to a body posture with excessive stresses at the neck and wrist regions.

From the various studies conducted among computer users, it is so evident that anybody using a computer in their work setting for a longer period can develop computer-related health problems, which is preventable to a great extent through proper ergonomic interventions. However, there is no formal education or orientation on computer ergonomics for office workers. So the present study will help the investigator to explore the knowledge and self-reported practice of ergonomics among office computer users, followed by the demonstration of ergonomic. This computer ergonomic which is based on their current knowledge and practice will create an awareness of computer ergonomics and aid the computer users for the identification and prevention of risk factors that cause musculoskeletal disorders and eye strain.

Although computers have been used in health care since 1960's the use of computer in the field of nursing has increased recently. Computer is useful tool in Educational because it allows for an individual a self paced learning. Computer Assisted Instruction is a method of teaching that involves interaction between the learner and the computer. The computer takes on the role of a teacher. Computer can perform a wide range of activities that save time and help nurses provide quality nursing care. Computerized documentation is legible and it can be programmed to identify the data and time of all entries as well as the initials or the name of the person making the entry. The computer helps nurse researcher to collect and analyze data, prepare research reports and disseminate research findings. Computer is also useful tool in nursing administration and a number of computer programs are designed to

assist nurse administrators. Though computer is useful tool in all these aspects it has many ill effects on vision and health.

As a community health nurse, the researcher took the responsibility of assessing and providing awareness among a section of population who are at risk of occupational hazards and the investigator personally experienced some visual problems while working with the computer for limited duration and also the investigator came across the people who are working in software companies and suffering from physical problems like neck pain, wrist pain, back pain, stiffness, shoulder pain, blurred vision, watering eye etc. due to technological advancement and modernization many individuals are adopted to computer including young children without aware of computer related problems and necessary preventive measures.

Hence the investigators felt the need that it would be beneficial if study is conducted among software professionals regarding preventive measures for computer related physical Problems. To provide the necessary information to software professionals keeping in view the effects of computer on physical discomforts and preventive measures to overcome them by changing of environment at computer workstations the investigator felt the need for educating the target group through demonstration of ergonomics. Demonstration of ergonomics is helping the individual to understand and manipulate the ergonomic techniques easily. It is effective in increasing the knowledge level of individuals and clarifies their doubts then and there on demonstration time. Demonstration of ergonomic is a simple, convenient, inexpensive method for teaching to individuals. This is evidenced by many studies. The investigator intended to demonstrate the ergonomics which will be administered to the software professionals and its effectiveness in achieving the desired goals will

be tested and thereby minimizing the incidence of physical discomforts among software professionals.

1.2 STATEMENT OF THE PROBLEM

A study to evaluate the Effectiveness of Ergonomics on physical discomfort among computer users at selected IT office in Madurai.

1.3 OBJECTIVES OF THE STUDY

- To assess the level of physical discomforts among computer users in selected IT office at Madurai.
- To evaluate the effectiveness of ergonomics among computer users in selected IT office at Madurai.
- To determine the association between the levels of physical discomfort with their selected socio demographic variables.

1.4 HYPOTHESES

- H1: The Mean post test score is significantly lower than the mean pre test score of Physical discomforts among the computer users.
- $H_{2:}$ There is a significant association between the levels of physical discomfort with their selected socio demographic variables.

1.5 OPERATIONAL DEFINITION

Effectiveness: In this study, Effectiveness refers to determine the extent to which the intervention has brought intended result in terms of significant difference in pre and post test of physical problems due to use of computer which is measured by RULA (Rapid Upper Limb Assessment) scale measurement.

Ergonomics: In this study, Ergonomics refers to the demonstration of using right method of body posture and stretching exercise to the computer users to reduce the physical discomfort. Stretching exercise focused to the parts of head, eye, neck, upper limb, back, lower limb.

Physical Discomfort: In this study, Physical discomfort refers to a risk of injury to the muscle of neck, arm, shoulder, wrist, trunk, legs and related soft tissues caused by using computer.

Computer Users: In this study, computer users refer to office workers who use computer for at least four hours continuously per day.

IT Office: In this study, IT office refers to the working place with computers and its accessories like, keyboard, mouse, C.P.U (Central processing unit), etc., for the people those who got skill in using the computers, which is located in Great Minds Business Solution India Ltd IT office at Madurai.

1.6 ASSUMPTION

- Computer users may have physical discomfort due to improper use of body mechanics while operating computer.
- Ergonomics may not give any adverse reaction to the computer users.
- Ergonomic techniques may be easily adopted by the computer users.

1.7 DELIMITATION

Study is limited to

1. Staffs who are working continuously with the computer more than 4 hours per day.
2. Staffs in Great Minds Business Solution India Ltd in Madurai.

3. Sample size is 40
4. The data collection period is limited to 4-6 weeks.

1.8 PROJECTED OUTCOME

The study is expected to yield the outcome that Demonstration of ergonomic intervention will reduce the physical discomfort among computer users working at Selected IT offices Great Minds Business Solution India Ltd in Madurai.

Review of Literature

CHAPTER - II

REVIEW OF LITERATURE

The review of literature entails systematic identification, location scrutiny and summary of written material that contains information relevant to the problem under study. An extensive review of literature relevant to the research topic was done to gain insight and to collect maximum information for laying the foundation of the study. A literature review helps to lay the foundations for the study, when researchers are trying to make sense of their finding. The purpose of review of literature is to obtain a comprehensive picture of the state of knowledge and in depth information about the effectiveness of ergonomics on physical discomfort among computer users at selected IT office in Madurai.

This section has two parts

Part – I : Review of literature

Part- II : Conceptual Frame Work

PART – I REVIEW OF RELATED LITERATURE

This section on literature is divided into 4 parts which explores the literature and the previous studies of effectiveness of ergonomics on physical discomfort among computer users in selected IT office at Madurai.

The review of literature is organized under the following headings:

2.1 : Literature related to ergonomics in various occupational settings.

2.2 : Literature related to ergonomics in office.

2.3 : Literature related to prevalence of physical discomforts among computer users.

2.4 : Literature related to effects of ergonomics on physical discomfort among computer users.

2.1 LITERATURE RELATED TO ERGONOMICS IN VARIOUS OCCUPATIONAL SETTINGS.

Garbin AJ, Garbin CA, Diniz DG, (2011) conducted a descriptive, analytical and observational study in Brazil among undergraduate dental students to examine their knowledge of ergonomic postural requirements and their application during clinical care. The results showed that 65.7% of the ergonomics knowledge questions were answered correctly, and 35% of the photographic cases were in compliance with ergonomic requirements (+ 0.67, $p<0.0001$) and concluded that knowledge of ergonomics postural requirements, and their clinical application among the dental students surveyed were not satisfactory. The reasons for the learning difficulties encountered by the students should be identified to improve the learning process.

Ro-Ting Lin, Chang-Chuan, (2009) conducted a prospective comparative intervention study in Taiwan over 3 months to evaluate the effect of ergonomic workstation design on musculoskeletal risk factors and musculoskeletal symptoms reduction among 40 female semiconductor fabrication room workers by using observation checklist and Nordic musculoskeletal questionnaire. The study found that there was significant difference in discomfited shoulder postures between two groups at one month ($p = 0:05$) and three months ($p = 0:02$) after intervention. Postural analysis by Rapid Upper Limb Assessment showed high score (7/7). These indicate the vulnerability of many of the postures to musculoskeletal disorders and injury. The study concluded that majority of the activities are in the high risk category and

demands immediate ergonomic intervention in the form of tool, workstation and process design.

2.2 : LITERATURE RELATED TO ERGONOMICS IN OFFICE

A Radas, (2013) conducted an experimental study among 16 full-time clerical and office workers using computer in United States of America to assess the effectiveness of the combined approaches of education; workstation redesign, and task modification as a comprehensive work injury prevention programs for clerical/office workers. Experimental group reported lower average neck ache/pain and Upper Back ache/pain frequencies but higher Eyestrain/fatigue and Lower Back ache/pain frequencies than the control group. The experimental group workers reported greatest compliance with the use of issued ergonomic equipment (Mean = 3.9, Standard Deviation = 0.38), followed by the performance of modified job duties (Mean = 2.7, Standard Deviation = 0.49), and lastly, performance of issued stretches/breaks (Mean= 2.4, Standard Deviation = 0.79). They were highly satisfied with the individualized work injury prevention programs (Mean=9.0, Standard Deviation = 0.49).

Meirav Taieb-Maimon, Julie Cwikel, Bracha Shapira, Ido Orenstein (2011) conducted an intervention study in Israel among office workers using computers to evaluate an effect of ergonomic intervention on musculoskeletal risk. A pre-test/post-test design was used. Musculoskeletal risk was evaluated using the Rapid Upper Limb Assessment (RULA) method.

The result showed that the RULA scores of the control group did not differ significantly throughout the experiment (mean _ SD of 4.02 _ 0.52). The average RULA scores of the ergonomic intervention training group dropped from an initial

mean _ SD of 3.70 _ 0.52 during the baseline phase to mean _ SD of 2.50 _ 0.47, respectively.

Michelle Robertson, Benjamin C. Amick , Kelly DeRangoc, Ted Rooneyd, Lianna Bazzanid, Ron Harriste, (2010) undertaken a large-scale field intervention study to examine the effects of office ergonomics training coupled with a highly adjustable chair on knowledge and musculoskeletal risks among office workers. Office workers were assigned to one of two study groups: a group receiving a training-only group and a control group. A pre/post test design was used. The RULA scale is used to collect data. The ergonomic intervention group experienced a significant improvement in computing postures post-intervention compared to the control group for the left side of the body (2.25 $P<0.05$) and for the right side of the body (1.94 $p<0.05$).

Nieuwenhuisjsen ER (2009) conducted an exploratory study to investigate the impact of a multi-component ergonomic intervention on health behavior change among 40 office/computer workers in preventing repetitive strain injuries using a comprehensive 16 questionnaire at three different times. The results showed that multi component ergonomic intervention 62.5% of the 40 participants made changes in their behavior patterns in a positive direction. The variable self-efficacy combined with the intervening variable "intention" is the strongest and most significantly related to health behavior change at the $p < 0.01$ level .

2.3 : LITERATURE RELATED TO PREVALENCE OF PHYSICAL DISCOMFORT COMPUTER USERS.

Martin Varkey CHN Fr Muller (2013). Conducted a cross-sectional study in India to determine the prevalence of eyestrain among computer operators and its association with various epidemiological factors among 419 subjects using pre-tested

questionnaire, personal interview. The result showed that 194 (46.3%) suffered from eyestrain during or after work on computer. Marginally higher proportion of eyestrain was noted in females compared to males. Occurrence of eyestrain was significantly associated with age of starting use of computer, presence of refractive error, viewing distance, and level of top of the computer screen with respect to eyes, use of antiglare screen and adjustment of contrast and brightness of monitor screen.

A Klussmann (2012) conducted a cross-sectional study in Germany among 1,065 employees, to determine the prevalence and the predictors of musculoskeletal symptoms in the upper extremities and neck at computer workstations using standardized questionnaire, standardized checklist and physical examination. The result showed that the prevalence of symptoms of the neck, shoulder region, hand/wrist, or elbow/lower arm was 55%, 38%, 21%, and 15% respectively. The duration of computer work had a significant impact on the frequency of neck symptoms in employees performing such work > 6 h/d. The study concluded that preventive measures at computer workstations should be focused on neck and shoulder symptoms (e.g. ergonomic measures, breaks to avoid sitting over long periods).

Priyanga Ranasinghe (2011) conducted a study in Sri Lanka to analyze the presence of Complaints of Arm, Neck and Shoulder in relation to the effects of exposure to physical and psychological factors, and their probable interactions among 2,500 computer office workers using Maastricht Upper extremity-Questionnaire, Visual-Display-Terminal workstation-checklist and knowledge questionnaire. The prevalence of Complaints of Arm, Neck and Shoulder in the study population was 56.9%. Prevalence of Complaints of Arm, Neck and Shoulder in males and females were 54.7% and 59.2% respectively ($p > 0.05$). The most commonly reported

complaints were in the forearm and hand region (42.6%), followed by neck complaints (36.7%) and shoulder and arm complaints (32.0%). The prevalence in Southern province was significantly lower than in the other provinces ($p < 0.001$). The study concluded that work-related physical factors, psychosocial factors and lack of awareness were all important associations of Complaints of Arm, Neck and Shoulder and effective preventive strategies need to address all three areas.

Deepak Sharan, Prakriti Parijat, Ajeesh Padinjattethil Sasidharan, Rameshkumar Ranganathan,Mathankumar Mohandoss, Jeena Jose (2011) conducted a retrospective study in India to examine the prevalence of adverse workstyle among 4,500 computer professionals and also to evaluate, if workstyle factors were predictors of pain and loss of productivity. The short-form workstyle questionnaire and pain questionnaire were used. Correlation analyses were used to examine the associations between the variables. *The results showed that the* 4,500 participants responded to the workstyle and pain questionnaire. 22% of participants were reported to have a high risk of an adverse workstyle. 63% of participants reported pain symptoms. Social reactivity, lack of breaks, and deadlines/pressure subscales of work style questionnaire were significantly correlated with pain and loss of productivity. Regression analyses revealed that workstyle factors and duration of computer use per day were significant predictors of pain. *This study concluded that* Workstyle seems to be a mediating factor for musculoskeletal pain, discomfort, and loss of productivity.

Juul-Kristensen B, Søgaard K, Strøyer J, Jensen C (2011) conducted a prospective study in Denmark to determine factors of computer work that predict musculoskeletal symptoms in the shoulder, elbow, and low-back regions using questionnaire on ergonomics, work pauses, work techniques, and psychosocial and

work factors. The results showed that in the follow-up, 10%, 18%, and 23% had symptoms more often in the elbow, shoulder, and low back, respectively, and 14%, 20%, and 22% had more intense symptoms which implies that, influence on work pauses, reduction of glare or reflection, and screen height are important factors in the design of future computer workstations.

F Gerr – (2011) conducted a prospective study in United States among 632 newly hired computer users to evaluate associations between posture and neck or shoulder and hand or arm physical discomfort and musculoskeletal disorders. Participants' postures were measured at entry, and they reported symptoms on weekly diaries. Participants reporting symptoms were examined for specific disorders. The result showed that keying with a greater downward head tilt, and presence of armrests on the participant's chair was associated with lower risk of neck or shoulder symptoms. Keying with elbow height below the height of the "J" key and the presence of a telephone shoulder rest were associated with a greater risk of neck or shoulder discomfort or neck or shoulder disorders. More than 50% of computer users reported musculoskeletal discomfort during the first year after starting a new job.

A Ekman (2011) conducted a study to investigate whether gender or different methods of operating a computer mouse have an effect on performance and musculoskeletal load through the use of a computer mouse. Thirty experienced computer mouse users, 15 men and 15 women, participated in the study. Electromyography, a force-sensing mouse, and subjective ratings were used to register muscular load. The result showed that the women worked with greater extension and range of motion and tended to work with a greater ulnar deviation of the wrist. They also applied higher forces to the mouse when expressed as a percentage of a maximum voluntary contraction and had higher muscular activity in

the right extensor digitorum. The study concluded that gender differences were found for musculoskeletal load, and for most of the measured variables, the women worked with higher loads than the men.

Andreea Niţa (2010) conducted a Retrospective study is to assess the prevalence of musculoskeletal complaints to computer workers and occupational risk factors among Romanian computer workers from several institutions in Romania, working in different areas - IT, commerce, administration, insurance. The result revealed in Analysis of musculoskeletal symptoms in the studied population. Most subjects (78.9%) confirmed the presence of musculoskeletal symptoms is related to computer work. Analyzing symptoms by gender, there are statistically significant differences: women present a greater frequency of symptoms in the neck ($p = 0.0004$), for other localizations there are no statistically significant differences related to gender. The predominant symptom reported was pain (73.4%). Other frequently reported symptoms were muscle stiffness (25.7%) and paresthesia (31%). In terms of gender differences, women reported significantly more presence of stiffness ($p = 0.02$).

S Eltayeb (2010) conducted a study to investigate the prevalence of Complaints of Arm, Neck and Shoulder in a Dutch population of computer workers and to develop a questionnaire aimed at measuring workplace physical and psychosocial risk factors for the presence of these complaints among 264 computer office workers using a structured questionnaire .The result showed that 54% of the respondents reported at least one complaint in the arm, neck and/or shoulder. The highest prevalence rates were found for neck and shoulder symptoms (33% and 31% respectively), followed by hand and upper arm complaints (11% to 12%) and elbow, lower arm and wrist complaints (6% to 7%).The study concluded that neck and

shoulder complaints are more frequently reported among Dutch computer workers than arm, elbow and hand complaints.

A. Sen And Stanley Richardson (2010) conducted a cross-sectional study among 136 computer users to survey the health problems associated with computer usage using questions on four main areas viz. Computer usage; awareness of ergonomic symptoms of cerebro vascular system and degree of overuse syndrome. The study showed that thirty six percent of the respondents used chairs with adjustable backrest while working on their computers, though 51 % of them knew how to adjust it. Only 20% of them had any idea about the Ergonomic seating posture. These preliminary findings suggest a great risk of developing overuse syndrome in neck and wrist regions amongst the sample population.

Zungu and Ndaba (2009) carried out a quantitative cross-sectional descriptive survey in South Africa, was to determine the prevalence of self reported musculoskeletal disorders and also to assess the association between the physical demands of their work and musculoskeletal disorders among 71 office workers in a private hospital. The result showed that a 76.1% had at one point in time been absent from work due to backache or other musculoskeletal problems. The most commonly affected regions were the back followed by the neck, wrists and shoulders. Furthermore, the prevalence of musculoskeletal disorders was associated with the physical work demands of the work, particularly between repetitive motions of upper limbs, and wrist extension when using the keyboard and forceful movements. Chi-square analysis of repetitive tasks and musculoskeletal disorders showed a strong association between the frequent use of a computer or keyboard including tasks involving repetitive movements and musculoskeletal disorders ($\chi 2 = 40.967$; $p<0.001$) and other administrative tasks involving upper extremities ($\chi 2 = 14.743$; $p = 0.005$). A

significant relationship between participants' performance of forceful repetitive tasks and musculoskeletal disorders ($\chi 2 = 16.964$; $p = 0.003$) was found.

EW Tornqvist (2009) conducted a prospective cohort study in Sweden to assess the influence of working conditions and individual factors on the prevalence of neck and upper limb symptoms among 1,283 professional computer users showed that the prevalence rate was 67, 41 and 47 cases per 100 person years for neck, shoulder and arm/hand symptoms, respectively. The comfort of the computer work environment and gender were related to the prevalence of symptoms in all body regions (Relative Risk = 1.5-1.9 and 1.8-2.1 for females, respectively). Duration of mouse use predicted arm/hand symptoms (Relative Risk = 1.7 for >or=3 h/day) and job strain (high demands and low decision latitude) predicted neck symptoms (Relative Risk = 1.6 and 2.2 for medium and high strain, respectively). The study concluded that preventive strategies to reduce neck and upper limb symptoms among computer users should include measures to reduce mouse use, to increase the comfort of the work environment and to reduce job strain.

Janwantangkul (2009) carried out a cross-sectional survey inBangkok for 2000 computer workers from 54 workplaces to find the prevalence of self-reported 19 musculoskeletal symptoms in the head/neck, shoulders, elbows, wrists/hands, upper back, low back, hips, knees and ankles/feet using a descriptive questionnaire. The result showed that prevalence of self-reported musculoskeletal symptoms attributed to work was 63%. Sites of symptoms, in order of prevalence, were head/neck (42%), low back (34%), upper back (28%), wrists/hands (20%), shoulders (16%), ankles/feet (13%), knees (12%), hips (6%) and elbows (5%). Female office workers were more likely to report symptoms in the head/neck, shoulder, upper back and ankle/foot regions than male counterparts ($P < 0.05$).

Xue. Liu, Rhoda, (2009) conducted a cross-sectional study to investigate computer workstation components, ergonomic injury-related symptoms, perceptions of current workstation, and ergonomics knowledge for student employees and faculty members (n=150) at Saint Louis University School. The project consisted of five parts such as initial survey, measurements of linear and postural angles, informational brochure and follow-up survey and the participants were divided into two groups: office and cubicle workers. The result showed that computer workers endured significantly more chronic discomfort/pain ($p=0.018$) and found a significant difference between participants' actual working postures in comparison to the neutral/ideal postures ($p<0.05$). The follow-up survey data indicated effectiveness of the intervention, more than 80% of all the participants agreed they learned more about ergonomics and felt confident to recognize and fix their ergonomic problems in the future. This study indicates intervention targeting people's knowledge has proven to be effective.

Anna-Maija Lehto (2009) conducted a survey in Finland to estimate the prevalence of musculoskeletal disorders among full-time computer users to examine how the prevalence varies by work environment; and to explore the association with work factors. Office workers (n = 298), customer service workers (n = 238) and designers (n = 247) were studied using questionnaire. The result showed that the prevalence's of musculoskeletal symptoms in the neck, shoulders, elbows, lower arms and wrists, and fingers were 63, 24, 18, 35 and 16%, respectively. The study concluded more consideration should be paid to the ergonomics of workstations, the placing of the mouse, the postures of the upper extremities and the handling of the mouse.

KL Noack (2009) conducted a study among college students to assess usage patterns and physical discomfort. 234 students completed a web-based questionnaire concerning computer use habits and physical discomfort respondents specifically associated with computer use. Students reported their computer use to be at least somewhat likely' 18 out of 24 h/day, compared to 12 h for the professionals. Students reported more uninterrupted work behaviors than the professionals. Younger graduate students reported 33.7 average weekly computing hours, similar to hours reported by younger professionals. Students generally reported more frequent upper extremity discomfort than the professionals. Frequent assumption of uncomfortable postures was associated with frequent discomfort. The study concluded that the need for intervention, including, training and education, prior to entry into the workforce.

Catherine Cook, Robin Burgess-Limerick, Sung won Chang (2008) carried out a cross-sectional study to determine whether any relationship existed between computer mouse use and musculoskeletal symptoms in a 18 sample of 270 computer mouse users in Sydney, Australia found that 75.7% of respondents reported symptoms (ache, pain or discomfort) in one or more body region in the last one month, with 46.4% reporting symptoms in one or more body regions in the last 7 days. A relationship was found between the variable of arm abduction ($p=0.07$) which is specific to mouse use and symptoms in the neck.

2.4: LITERATURE RELATED TO EFFECTS OF ERGONOMICS ON PHYSICAL DISCOMFORT AMONG COMPUTER USERS.

Martin Varkey CHN Fr Muller (2013). Conducted a randomized controlled trial to assess the effectiveness of a questionnaire based intervention program on the prevalence of arm, shoulder and neck symptoms, risk factors and sick leave in computer workers ($n=1673$). The result showed that the intervention group showed a

significant positive change (r= 0.48) in receiving information on healthy computer use, as well as a significant positive change regarding risk indicators for work posture and movement, compared to the usual care group. There were no significant differences in changes in the prevalence of arm, shoulder and neck symptoms or sick leave between the intervention, and usual care group.

Chantal Brisson, Ph.D., Sylvie Montreuil, Ph.D., Z Laura Punnett, ScDS (2012) conducted a study is to evaluated the effect of an ergonomic training program on workstation changes and on the prevalence of physical discomfort among 627 computer users at a large university. A pretest-posttest design with a reference group was used. In each group, the measurements involved direct observation of the workstations, a self- administered questionnaire, and a physical examination. The results revealed that the prevalence of all 3 of the postural stressors evaluated decreased in the experimental group after the training. The prevalence of physical discomfort decreased among the computer users under 40 years of age in the experimental group, from 29% to 13% determined by questionnaire and from 19% to 3% determined by physical examination. In other groups, there was no significant change in the prevalence of physical discomfort.

GE Voerman (2012) conducted a study to investigate the effects of ambulant myo feedback training, including ergonomic counseling and ergonomic counseling alone, on work-related neck-shoulder pain and disability. Seventy-nine female computer workers reporting neck-shoulder complaints were randomly assigned to myo feedback training, including ergonomic counseling and received four weeks of intervention. Pain intensity in neck, shoulders, and upper back, and pain disability, were measured at baseline, immediately after intervention, and at three and six-month follow-up. The result showed that pain intensity and disability had significantly decreased immediately after four weeks myo feedback training, including ergonomic counseling, and the effects remained at follow up. No differences were observed

between the myo feedback training, including ergonomic counseling group for outcome and subjects in both intervention groups showed comparable chances for improvement in pain intensity and disability.

Greene BL, DeJoy DM, Olejnik S (2011) did a study to evaluate the effectiveness of an active ergonomics training program in computer users. Eighty-seven symptomatic and asymptomatic employees who worked at a computer for a minimum of 10 hours per week took part in a prospective randomized controlled study. The result showed that, After receiving active ergonomics training program, risk factor exposure was significantly reduced for participants at higher risk [$F(1,82) = 6.42$, $p < 0.01$]. Significant increases in knowledge [$F(1,74) = 8.39$, $p < 0.01$], self-efficacy [$F(1,73) = 6.95$, $p < 0.01$], and outcome expectations [$F(1,75) = 8.75$, $p < 0.01$] were found in the intervention group. When the participants were stratified according to the presence of symptoms at baseline, the group with pain that received the active ergonomics training program intervention had significantly less upper back pain intensity ($z = -2.03$, $p < 0.05$), pain frequency ($z = -2.70$, $p < 0.01$), and pain duration ($z = -3.25$, $p < 0.01$) post-intervention than the control group with pain.

Shilpi Tomar (2010) conducted an experimental study in Bangalore; Karnataka is to evaluate effectiveness of ergonomics intervention with dynamic back extensor exercise on low back pain and disability among 40 computer professionals. Pre test and post test design was used. Visual analogue scale and the oswestry low back pain disability questionnaire were used to collect data. The result revealed that the experimental group were shown statistically improvement in Visual analogue scale (t-3.9847*, P<0.001) and in oswestry low back pain disability questionnaire (t-3.6497*, P<0.001) when compared to the control group.

AH Marangoni (2010) conducted a comparative study to evaluate the effects of regular ergonomic stretching exercises on pain associated with working at a computer workstation, and to ascertain whether the type of media used for ergonomic

exercise instruction had an effect on outcomes. Sixty-eight volunteers were divided into three equivalent groups. A pretest posttest- control group design with cluster randomization was used. Two intervention groups were directed to stretch once every six minutes. One group (n = 22) was reminded to stretch via a computer program, the second group (n = 23) by using a hard copy version and written instructions, and a third group received no intervention. The result showed a significant reduction in pain of 72% ($p < 0.001$) for the computer generate stretching program, and of 64% ($p < 0.001$) using the hardcopy version of the intervention. The control group had an increase in pain of 1%.

Paula T Hakala , Lea A Saarni, **Ritva L Ketola Erja T Rahkola**. **Jouko J Salminen** and **Arja H Rimpela (2010)** conducted a cross- sectional study is to assess the Computer-associated health complaints and sources of ergonomic instructions in computer-related issues among 6961 Finnish adolescents. The researchers tested the associations of computer use time and received ergonomic instructions (predictor variables) with computer-associated health complaints (outcome variables) using logistic regression analysis. The result showed that prevent computer-associated complaints, 61.2% reported having been instructed to arrange their desk/chair/screen in the right position, 71.5% to take rest breaks. The older age group (16 -18 years) reported receiving instructions or being self-instructed more often than the 12 to 14 year-olds ($p < 0.001$).

Jorgen R Jepsen and **Gert Thomsen (2010)** conducted a study to assess the effectiveness of stretching on Prevention of upper limb symptoms and signs of nerve afflictions in computer operators in Denmark. Computer operators in two divisions, 125 and 59, respectively of an engineering consultancy company were invited to answer a questionnaire on upper limb symptoms and to undergo a blinded neurological examination. Participants in one division were subsequently instructed to participate in an upper limb stretching course at least three times during workdays in a

six-month period. Subjects from the other division served as controls. Perceived changes of pain were recorded and individual and patterns of physical findings assessed for both groups at baseline and at follow-up. The result showed that pain was significantly reduced in the intervention group but unchanged in controls (p=0.04).

R Khan (2009) conducted an observational cross-sectional study in Karachi to assess practices of ergonomics among desktop users of different professions through a self-reporting questionnaire. The study population comprised 210 males and 134 females. Of the total, 52% said they had heard about ergonomics, while 92% were aware of its importance. Knowledge about the importance of arm-rest (24%) and backrest inclination at 120° (32%) was there, but practiced by 21% and 31% respectively (p = <0.02). Straight placement of the wrist in line with elbow was known to 194(56.39%) and practiced by 138(40%), while 186(54.06%) respondents had knowledge about the ideal height of the chair, but it was adjusted only by 112(32%). Disproportion was observed between the knowledge and practices of correct viewing distance from the computer screen, maintaining print at the eye level, keeping computer screen free of glare and moving the chair for better keyboard.

T Slot (2009) conducted a study to evaluate the effect of forearm ergonomic support and ergonomic stretching exercise provided by the use of Workplace Board on perceived tension, comfort and productivity among female computer workers. 28 women participated in the study. Participants completed three sets of tension/discomfort questionnaires at two-week intervals. With the use of Workplace Board and ergonomic stretching exercise decreased perceived tension was reported in the left shoulder (p=0.04), wrist and low back in women. The Board was generally liked by all participants, and increased comfort and productivity in all areas, except for a negative effect on productivity of general office tasks.

PART – II

CONCEPTUAL FRAMEWORK

A conceptual framework is a set of related concepts. A concept is defined as a complex mental formation of an object, property or event that is derived from individual perception and experience.

A framework is the abstract logical structure of meaning that guides the developments of the study and the body of knowledge.

It is a theoretical approach to the study of problems that are scientifically based and emphasizes the selection, arrangement and classification of its concepts. A conceptual framework act as a building block for the research study. It provides a perspective regarding interrelated phenomena. It serves as a spring board for generating the research hypothesis.

This study is intended to evaluate the effect of ergonomics on relief of physical discomfort among computer users in selected IT office at Madurai.

Conceptual frame work is structures together in a meaningful way. Although relationship are posited in conceptual frame work, frequently neither the direction nor the relationships made explicit for use in practice of for testing in a research project. Here the conceptual framework was based on **Modified CIPP Model;** this model was created by **Daniel L. Stufflebeam** in **1960** to improve and achieve accountability for educational programs, the model has been adopted and employed in social programs, health profession and business etc. It has been employed internally by schools, universities and by individual teacher and other professionals desiring to assess and improve their services. It is an acronym that stands for **context, input evaluation, process evaluation and product evaluation.**

Context evaluation is to assess needs, problems, opportunities within in a defined environment, they aid evaluation users to define and assess goals and later reference assessed needs of targeted beneficiaries to judge program, course of instruction, counseling service, teacher evaluation system, or other enterprise and help prioritize goals. ***Input evaluation*** is to assess competing strategies and work plans and budgets of approaches chosen for implementation; they aid evaluation users to design improvement efforts, develop defensible funding proposals, detail action plans, record alternative plans that were considered, record basis for choosing one approach over others & help guide and assess planning. ***Process evaluation*** monitor, document and assesses the implementation of plans & activities, and interpret outcomes; they help evaluation users carry out improvement efforts and maintain accountability records of their execution of action plans. ***Product evaluation*** assess short term, long term, intended and unintended outcomes. They help evaluation users maintain their focus on meeting the needs of students or other beneficiaries' targeted needs; identify intended and unintended side effects; and make informed decisions to continue, stop, or improve the effort.

The model is used to evaluate both formative and summative assignments. Thus, the CIPP model is oriented to administration, development, effective services, and prevention of harm, accountability, dissemination, and research. The CIPP Model advocated that the purpose is **"NOT TO PROVE BUT TO IMPROVE".**

Context Evaluation

It highlights the environment, surrounding from where the individuals engage and interact. In this study it includes selected factors such as age, sex, education qualification, income, number of years using computer, duration of work, and work in

front of computer continuously, mode of travel to office, source of information. The setting of the study was Great minds business solution India ltd, Madurai.

Input evaluation

It specifies the resources used in the process such as men, money, material. In this study, it includes measuring pre test level of physical discomfort using RULA (Rapid Upper Limb Assessment) scale that assesses the biomechanical and Postural loading on the whole body with particular attention to the arm, wrist, neck, trunk and legs among computer users.

Process evaluation

It refers to evaluation of implementing process including the interaction between the client and care givers. In process the interaction is demonstration of ergonomics. Ergonomics includes a technique that how the human being well suited to use his/her body mechanics and stretching exercise for head, neck, shoulder, arm, wrists, trunk and legs while operating computer. Then administration of ergonomics to the computer users is for 28 days

Product evaluation

This information refers the output as a result of the intervention. It includes reassessment (post test) is done to assess levels of physical discomfort using the same tools among computer users.

Feedback

It refers to the information sent backward from the product evaluation to the input and the process in order to gain understanding and modify or accept the strategies.

The lesser the physical discomfort and Rapid Upper Limb Assessment scores obtained from computer users in post test, the more effective the ergonomic intervention is. A high or unchanged physical discomfort and Rapid Upper Limb Assessment score indicates the need to modify or intensify the ergonomic intervention.

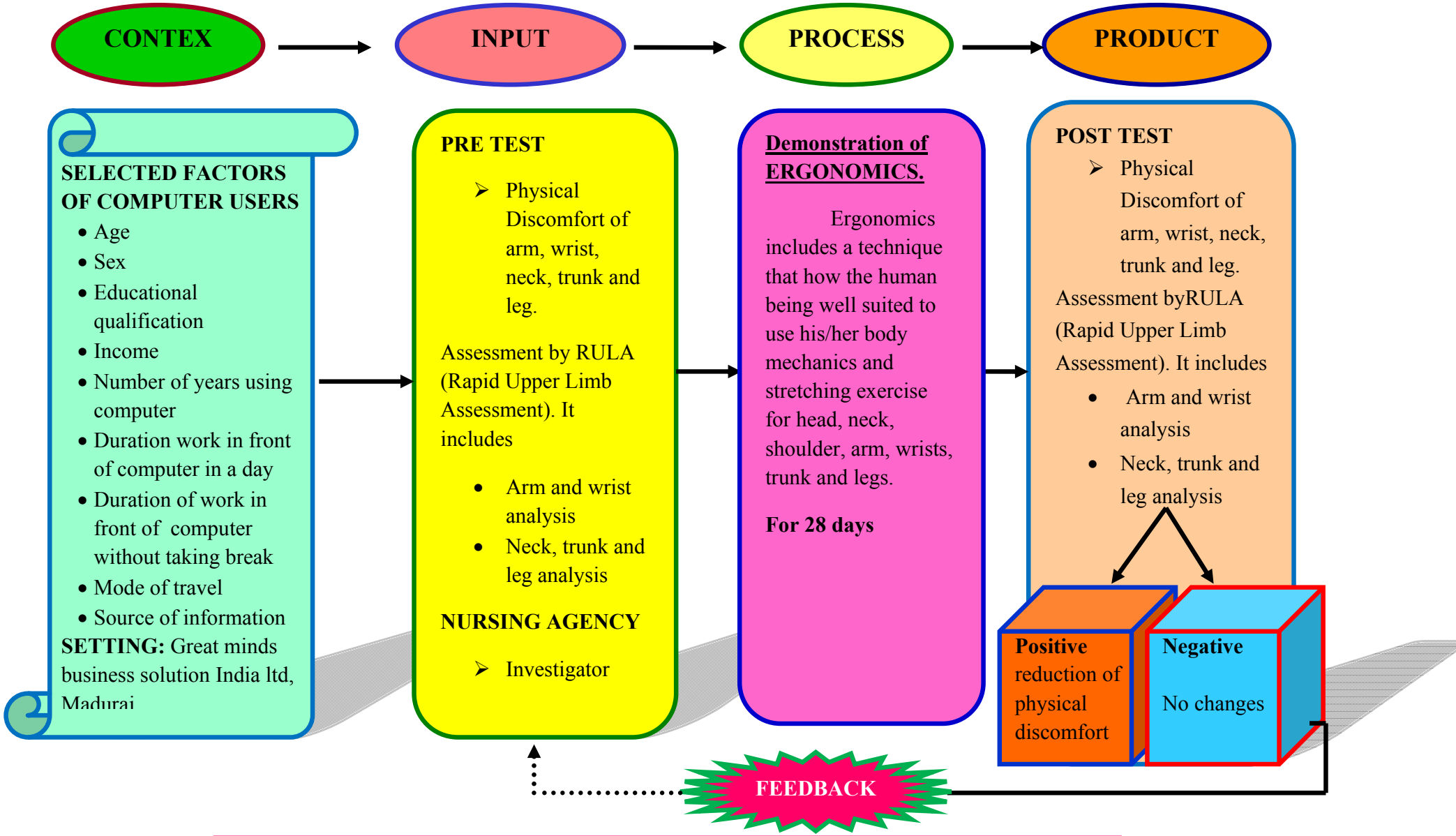


FIG: 1 CONCEPTUAL FRAMEWORK BASED ON MODIFIED CIPP MODEL, 1960.

Methodology

CHAPTER - III

METHODOLOGY

Methodology is the most important phase of the study. The methodology of research indicates the general pattern of organizing the procedures for gathering valid and reliable data for investigation. This chapter provides a brief description of method adopted by the investigator in this study. This includes the research approach, research design, setting of the study, population, sample, and sample size, sampling technique, criteria for sample selection, description of the tool, pilot study, data collection procedure, plan for data analysis and protection of human rights.

This present study aims to evaluate the effectiveness of ergonomics on physical discomfort among computer users at selected IT office in Madurai.

3.1 RESEARCH APPROACH

The research approach used for this study was quantitative approach.

3.2 RESEARCH DESIGN

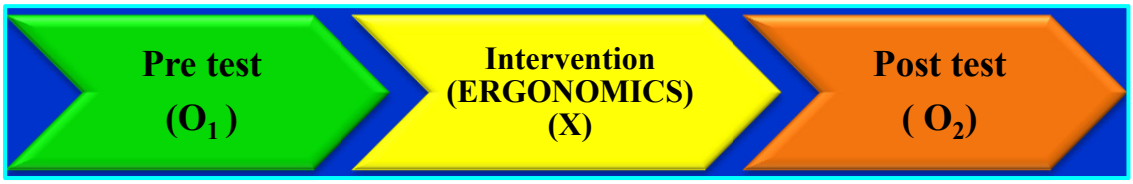
The research design selected for this study was **Pre experimental one group pretest – posttest design.**

O_1 X O_2

O_1 – Pretest: assessing pre test levels of physical discomfort with RULA (Rapid Upper Limb Assessment) scale among computer users.

X - Intervention: Demonstration of ergonomics to the computer users, 2 hours daily for 28 consecutive days.

O_2 - Post test: Assessing post test levels of physical discomfort with RULA (Rapid Upper Limb Assessment) scale among computer users after 28 days.



Pre experimental one group pretest posttest design.

A single group was selected and dependent variable (Physical Discomfort) was measured by RULA (Rapid Upper Limb Assessment) scale before introducing an intervention. The intervention Ergonomics was introduced and again dependent variable (Physical Discomfort) was measured.

3.3 RESEARCH VARIABLES

Independent Variable: Ergonomics

Dependent Variable: Physical Discomfort

3.4 SETTING OF THE STUDY

The study was conducted at Great Minds Business Solution India Ltd in Madurai. The Great Minds Business Solution India Ltd is one of the best IT offices in Madurai. The IT office has 60 workers who are working with computers. The Great Minds Business Solution India Ltd IT office is located approximately 2 kilometers from our college. 40 staffs who are working with computer were included in the study and ergonomic intervention is provided for 2 hours a day with group sessions (10 staffs in each group) for 28 days.

3. 5 POPULATION

The study population comprised of all the compute users working in IT offices

The target population

Target population was the individuals those who were the computer users working in IT offices.

Accessible population

The study population comprised of Computer users with physical discomfort working at a selected IT office (Great Minds Business Solution India Ltd) in Madurai.

3.6 SAMPLE

The present study comprises of computer users working at selected IT Office (Great Minds Business Solution India Ltd) in Madurai and those who have fulfilled the inclusion criteria.

3.7 SAMPLE SIZE

The sample size consists of 40 computer users who had physical discomfort at a selected IT office (Great Minds Business Solution India Ltd) in Madurai.

3.8 SAMPLING TECHNIQUE

Samples for this study were through purposive sampling technique. According to Denise F. Polit and Cheryl. Tatano Beck (9^{th} edition, 2014), purposive sampling (or) judgmental sampling refers to that researchers might decide purposely to select people who are judged to be typical of the population (or) particularly knowledge under the study.

3.9 CRITERIA FOR SAMPLING TECHNIQUE

Inclusion criteria:

- Subject using the computers continuously more than 4 hours a day
- Subjects those who are having physical discomforts due to computer use
- Both male and female are included

Exclusion Criteria

- Subjects those who are not willing to participate
- Subjects were had previously diagnosed postural anomalies or recent back or neck injuries.
- Subjects those who are having severe risk of injury.
- Subjects those who are participate in the pilot study.

3.10 DEVELOPMENT OF THE TOOL & TECHNIQUE

The self administration and observation schedule was organized in two sections, section A and section B respectively.

Section A **:** Consists of demographic variable which includes 10 items like age, sex, educational status, religion, number of year using computer, income, source of information, Number of hours spent on a computer per day, without taking break, number of hours working in front of computer, mode of travel to office.

Section B **:** Consist of RULA (Rapid Upper Limb Assessment) scale. The data was collected from all subjects by observation method.

3.11 SCORING PROCEDURE

PART A: Demographic Variable

PART B: RULA (Rapid Upper Limb Assessment) Scale, RULA is a postural targeting method for estimating the risks of work-related discomforts. A RULA assessment gives a quick and systematic assessment of the postural risks to a worker. Scores were calculated by summing the scores for the given items. The scores of each respondent over the scales are then evaluated as per the severity rating index below.

- 1 - 2 - No risk of injury
- 3 - 4 - some risk of Injury

- 5 – 6 - More risk of Injury
- 7 - Severe risk of Injury

Technique: Observation Method.

3.12 CONTENT VALIDITY

In order to measure, the content was validated and finalized by 5 experts in the field of preventive and social medicine, physiotherapy, community health nursing. This same tool was used for the pilot study in this same setting to assess the feasibility of the study. The result of the pilot study evidenced that, there was a feasibility to conduct a main study in same setting.

3.13 RELIABILITY OF THE TOOL

The reliability of a measuring instrument is a major criterion for assessing its quality and adequacy. Reliability is the consistency with which it measures the target attribute. The reliability of the tool was done by test retest method.($r = 0.9$). Hence it shows that the tool was considered highly reliable for producing with the main study.

3.14 PILOT STUDY

Pilot study was conducted at a non study setting from 1.8.2014 to 7.8.2014 test the feasibility of the setting. 10 samples were selected and included in the study. RULA (Rapid Upper Limb Assessment) scale was used to assess the level of physical discomfort among the computer users. Ergonomic intervention demonstrated to the subjects as a group and monitored them to perform 2 hours, daily for 7 days. At the seventh day, post test was done by using the same scale. The result evidenced that there is no significant difference between pre and post test score of physical discomfort. Researcher's consistent study proved the effectiveness of ergonomics only after 14 days

intervention. Hence in this study researcher have seen the feasibility of study setting to Conducting main study in selected IT office.

3.15 PROCEDURE FOR DATA COLLECTION

Prior to data collection, the necessary permission was obtained from ethical committee, Madurai Medical College, Madurai and the Administrative Director of Great minds Business Solution India Ltd, Madurai. Written consent was obtained from the subjects after self introduction and explanation regarding nature of the study.

The data collection procedure has been completed in two stages. First, Pre test was given to assess the levels of physical discomfort by using RULA (Rapid Upper Limb Assessment) scale for first 2 days. 15 minutes was taken for each client to assess the level of physical discomfort by observation method. Subjects were divided into 4 groups that are 10 members in each group. The Ergonomic intervention was demonstrated for the subjects from the third day, 2 hours daily for 28 consecutive days. Time schedule for ergonomic intervention for each group,

8:00 am – 10:00 am for I group,

10:30 am – 12:30 pm for II group,

1:30 pm – 3:30 Pm for III group

3:30 pm – 5:30pm for IV group.

Subjects were encouraged to redemonstrate Ergonomic intervention. Subjects were observed while practicing ergonomic intervention daily. A period of 28 days was allowed for subjects to practice ergonomic intervention before reassessing the physical discomfort level on the 29^{th} day (post test). On the 29^{th} and 30^{th} day the post test was done to assess the effectiveness of Ergonomic intervention.

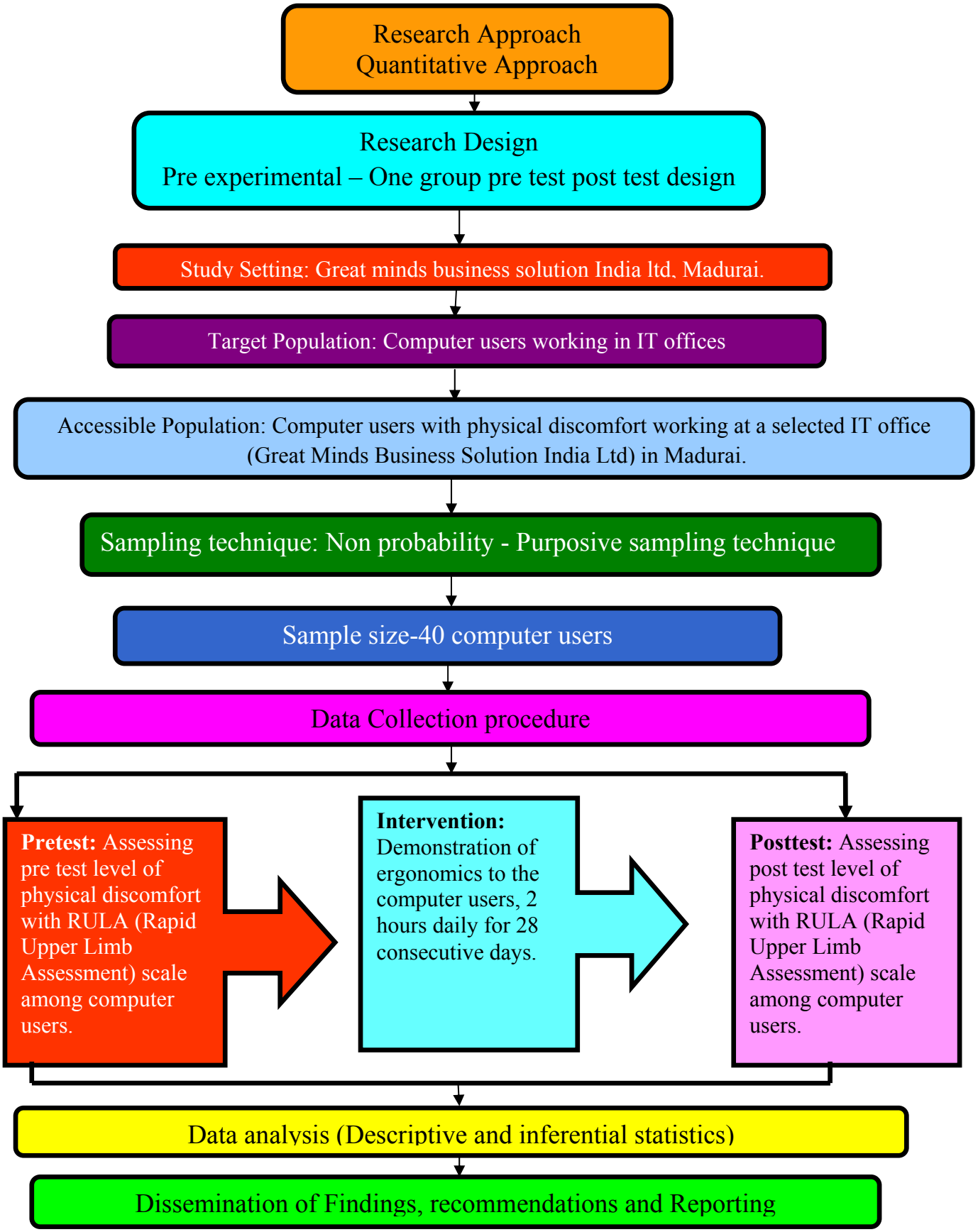
3.16 PLAN FOR DATA ANALYSIS

The collected data was subjected to statistical analysis using descriptive statistics and inferential statistics. Demographic variables of the subjects were analyzed by using the methods of frequency and percentage distribution. Mean and standard deviation were used to analyze the levels of physical discomfort among the computer users. Paired 't' test was used to determine the effectiveness of Ergonomic intervention in reducing the levels of physical discomfort among the computer users. Chi – square test was used to find out the association between the levels of physical discomfort and selected demographic variables among computer users. The findings of the study were expressed in the form of figures and tables.

3.17 PROTECTION OF HUMAN RIGHTS

The research proposal was approved by the ethical committee experts prior to the pilot study and permission for the main study was obtained from the Director of Greatminds Business Solution India Ltd, Madurai. An informed consent was obtained from each computer users before starting the data collection, assurance was given to the computer users, the confidentiality and privacy would be maintained throughout the study.

FIG: 2. SCHEMATIC REPRESENTATION OF THE STUDY



Data Analysis And Interpretation

CHAPTER - IV
DATA ANALYSIS AND INTERPRETATION

Polit (2004) states that statistical analysis is a method of rendering quantitative information and elicits meaningful and intelligible form to research data. This chapter deals with the analysis and interpretation of the data collected and thereby to assess the "A study to evaluate the Effectiveness of Ergonomics on physical discomfort among computer users at selected IT office in Madurai." Collected data were statistically analyzed by the researcher to summarize, organize, evaluate, interpret and communicate numeric information. The collected data deals with socio demographic variables, pre and post assessment of physical discomfort among computer users. The data which analyzed were tabulated and presented according to the objectives of the study.

The data collected were edited, tabulated, analyzed and interpreted. The findings were organized and presented in the following orderly sections;

SECTION I: Distribution of Socio demographic variables among computer users.

SECTION II: Distribution of levels of physical discomfort among computer users in the pre test and post test.

SECTION III: Effectiveness of ergonomics on physical discomfort among computer users.

SECTION IV: Association between post test levels of physical discomfort and selected Socio demographic variables among computer users.

SECTION – I

DISTRIBUTION OF SOCIO DEMOGRAPHIC VARIABLES AMONG COMPUTER USERS.

TABLE- 1

FREQUENCY AND PERCENTAGE DISTRIBUTION OF SOCIO DEMOGRAPHIC VARIABLES OF COMPUTER USERS

(n=40)

S.NO	DEMOGRAPHIC VARIABLES		FREQUENCY	PERCENTAGE
1.	Age	21-30 YRS	**32**	**80%**
		31-40 YRS	**8**	**20%**
		41-50 yrs	**0**	**0%**
2.	Gender	Male	**14**	**35%**
		Female	**26**	**65%**
5	Educational qualification	Graduation	**28**	**70%**
		Post Graduation and above	**8**	**20%**
		Diploma	**4**	**10%**
4.	Number of years using the Computer	<1	**4**	**10%**
		1 to 5	**26**	**65%**
		5 to 10	**8**	**20%**
		>10	**2**	**5%**
5.	Religion	Hindu	**34**	**85%**
		Christian	**4**	**10%**
		Muslim	**2**	**5%**

6.	Source of Information	Colleagues	**0**	**0%**
		Television and Internet	**0**	**0%**
		Books	**0**	**0%**
		Don't Know	**40**	**100%**
7.	Monthly Income	Less than 5000	**0**	**0%**
		5001-10000	**34**	**85%**
		10001-20000	**6**	**15%**
		20001 and above	**0**	**0%**
8.	Duration of work in a day in front of computer	4 to 5 hours	**8**	**20%**
		5 to 6 hours	**10**	**25%**
		6 to 7 hours	**4**	**10%**
		7 hours and above hours	**18**	**45%**
9	Without taking break, duration of work in fron of computer	0 to 1 hour	**2**	**5%**
		1 to 2 hours	**12**	**30%**
		2 to 4 hours	**14**	**35%**
		More than 4 hours	**12**	**30%**
10	Mode of travel to Office	Bike	**14**	**35%**
		Bus	**24**	**60%**
		Walk	**2**	**5%**
		Car	**0**	**0%**

The above table reveals,

Regarding, Age distribution of subjects stated that, majority 32(80%) were between 21-30 years of age, 8(20%) were between 31-40 years of age and no one were between 41-50 years of age. Among the 40 subjects 14(35%) were males and the remaining 26(65%) were females.

According to educational qualification, majority 28(70%) had graduation and 8 (20%) had Post Graduation and above, 4 (10%) had Diploma.

Regarding number of years using Computer, majority 26 (65%) subjects were using computer 1 to 5 years, 8(20%) were using computer 5 to 10 years,4 (10%) were using computer less than one year, remaining 2(5%) samples were using 10 years and above.

With regard to religion majority 34(85%) subjects were belongs to Hindu, 4(10%) were belongs to Christian, 2(5%) were belongs to Muslim.

Almost 100% subjects were not received information regarding ergonomics from any source.

In the aspect of monthly income majority 34(85%) subjects were earn between Rs.5001-Rs.10000, 6(15%) were earn between Rs.20001 and above, no one earning less than Rs. 5000.

With the view of duration of work in a day, majority 18 (45%) subjects were working in front of computer between 7 hours and above, 10(25%) were working in front of computer between 5 to 6 hours, 8 (20%) were working in front of computer between 4 to 5 hours, 4 (10%) were working in front of computer between 6 to 7 hours.

With regard of without taking break, majority 14(35%) subjects were working in front of computer between 2 to 4 hours, 12(30%) were working in front of computer more than 4 hours, 12(30%) were working in front of computer between 1 to 2 hour,2 (5%) were working in front of computer between 0 to 1 hour.

Regarding Mode of travel to office, 14(35%) subjects were commuting by bike, 24(60%) were commuting by bus, 2(5%) were commuting by walk, no one were commuting by car.

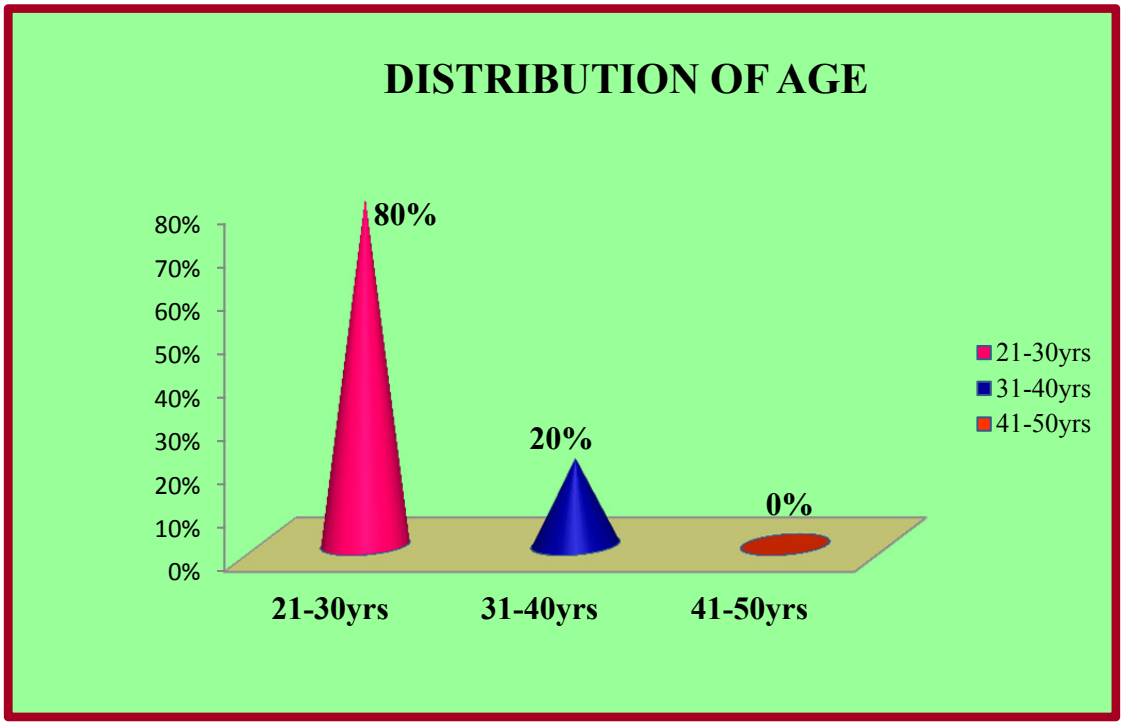


FIGURE 3: PERCENTAGE DISTRIBUTION ACCORDING TO THEIR AGE IN YEARS AMONG COMPUTER USERS

The above cone diagram represents, majority of computer users 80% were belongs to 21-30 yrs, 20% were belongs to 31-40yrs, no were belongs to 41-50yrs

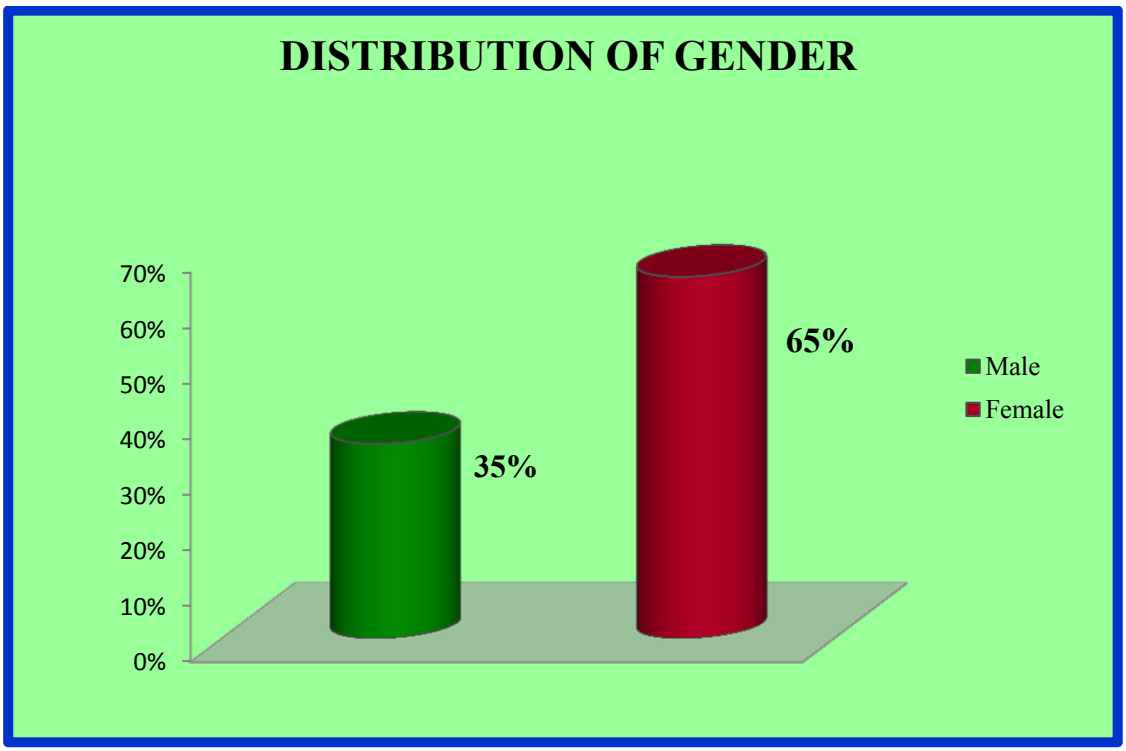


FIGURE 4: PERCENTAGE DISTRIBUTION ACCORDING TO THEIR GENDER AMONG COMPUTER USERS

The above cylindrical diagram represents, majority of computer users 65% were female, 35% were male.

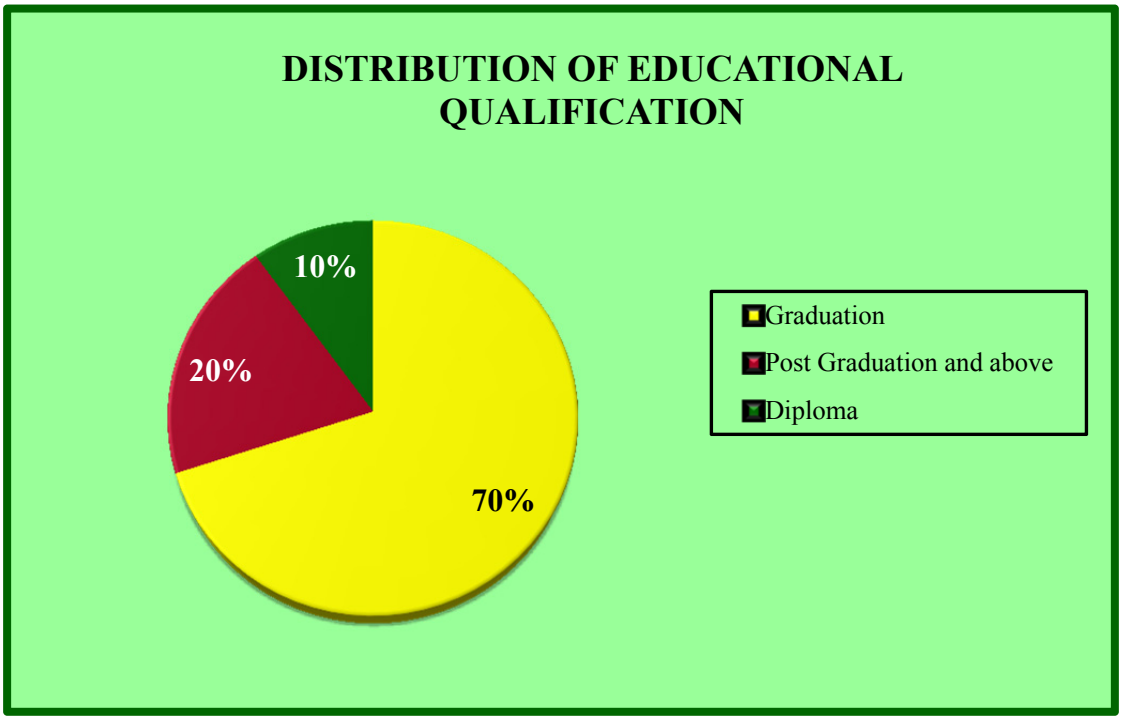


FIGURE 5: PERCENTAGE DISTRIBUTION ACCORDING TO THEIR EDUCATIONAL QUALIFICATION AMONG COMPUTER USERS

The above pie diagram represents, majority of computer users 70% were had their education up to graduation, 20% had post graduation and 10% were had their education up to diploma.

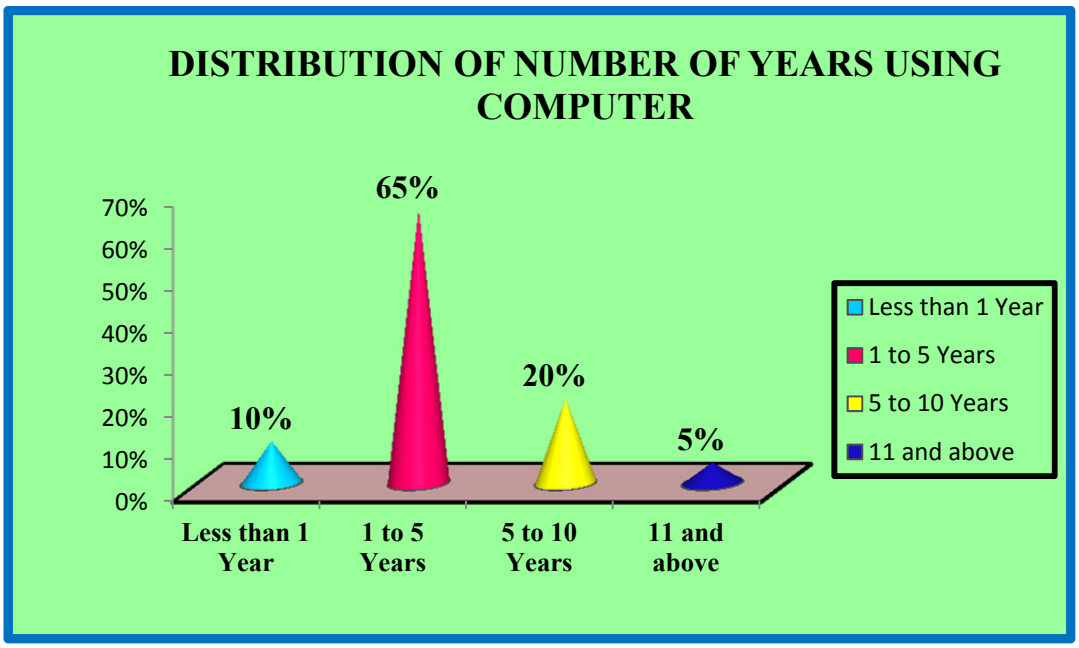


FIGURE 6: PERCENTAGE DISTRIBUTION ACCORDING TO THEIR NUMBER OF YEARS USING COMPUTER AMONG COMPUTER USERS

The above cone diagram represents majority of computer users 65% were using computers from 1 to 5 users, 20% using computer from 5 to 10 yrs, 10% using computer below 1 year, 5% from 11 years and above.

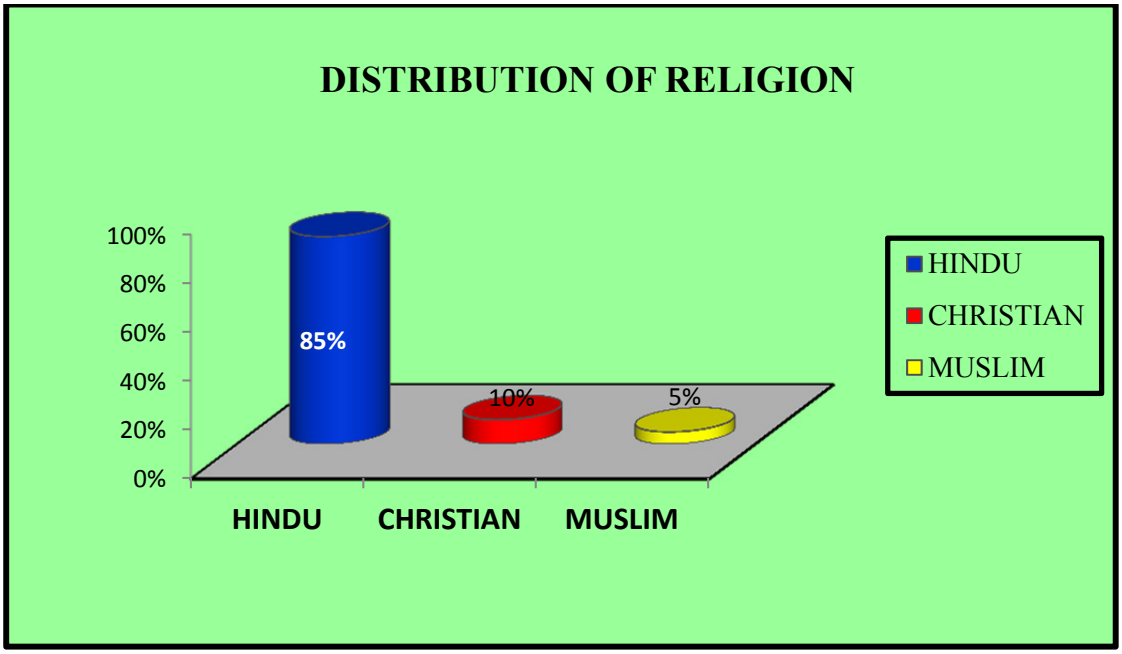


FIGURE 7: PERCENTAGE DISTRIBUTION ACCORDING TO THEIR RELIGION AMONG COMPUTER USERS

The above cylindrical diagram represents majority of computer users85% were belongs to Hindu, 10% were belongs to Christian, and 5% were belongs to Muslim.

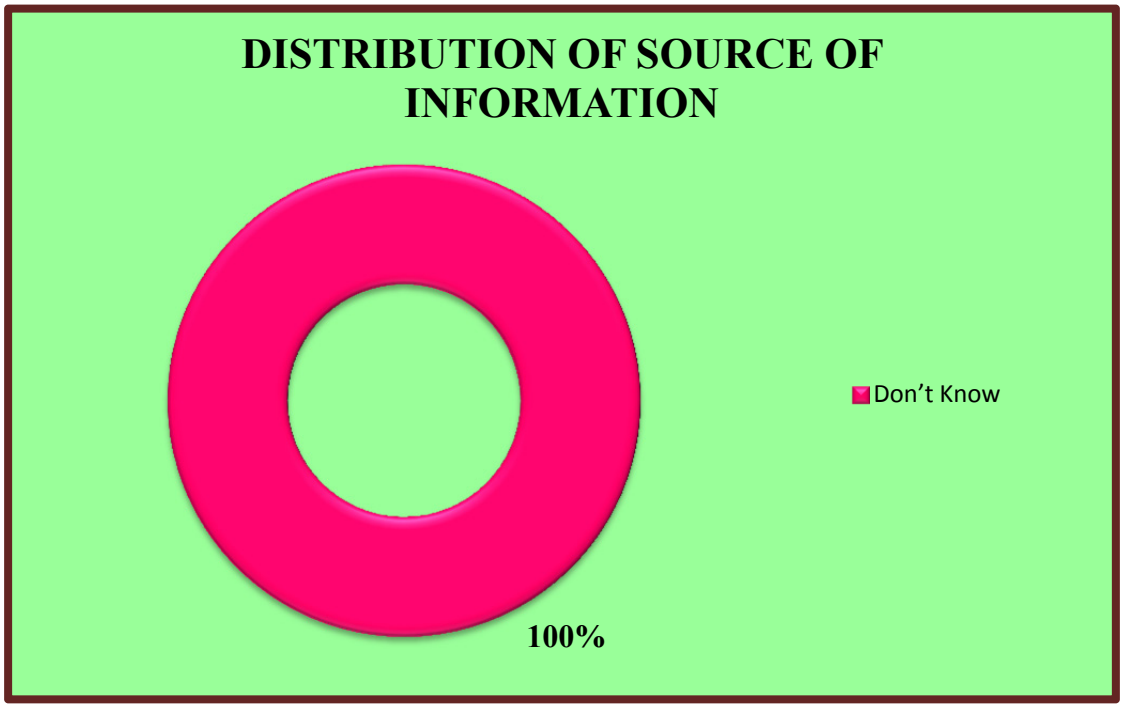


FIGURE 8: PERCENTAGE DISTRIBUTION ACCORDING TO THEIR SOURCE OF INFORMATION REGARDING ERGONOMICS AMONG COMPUTER USERS

The above doughnut diagram represents that all selected computer users 100% were not received any kind of information about ergonomics.

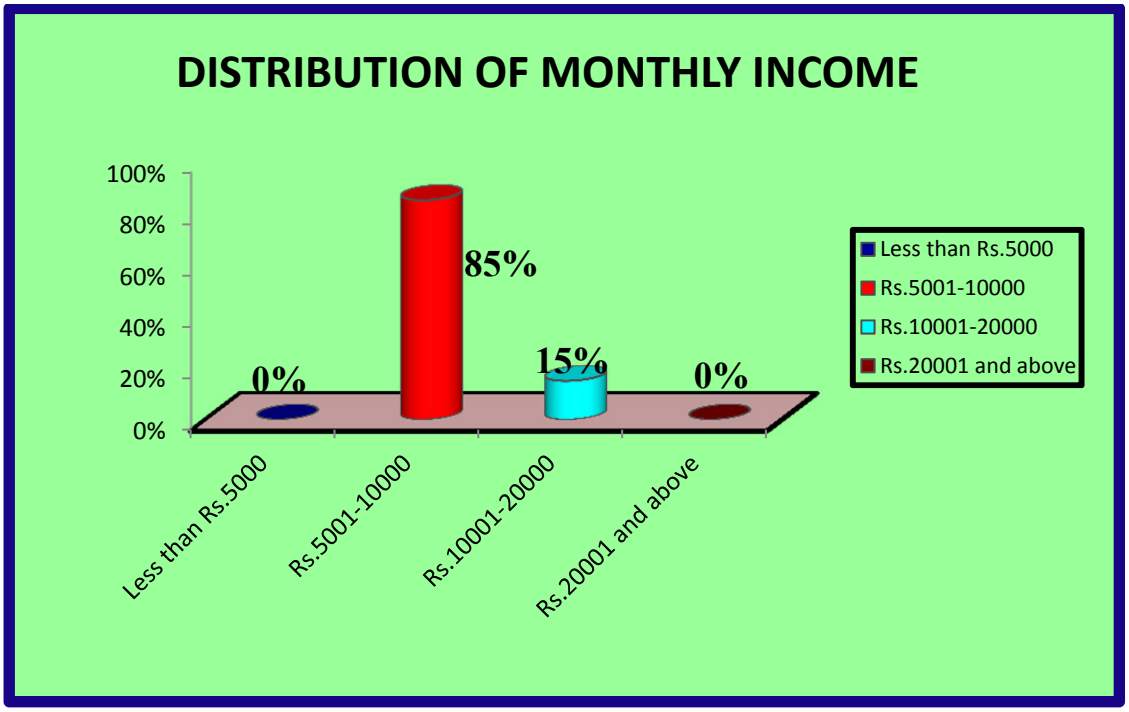


FIGURE 9: PERCENTAGE DISTRIBUTION ACCORDING TO THEIR MONTHLY INCOME AMONG COMPUTER USERS

The above cylindrical diagram represents, majority of computer users 85% were earn Rs.5001-Rs.10000, 15% were earn Rs.10001-20000 and nobody were earn between less than Rs.5000 and Rs. 20001 and above.

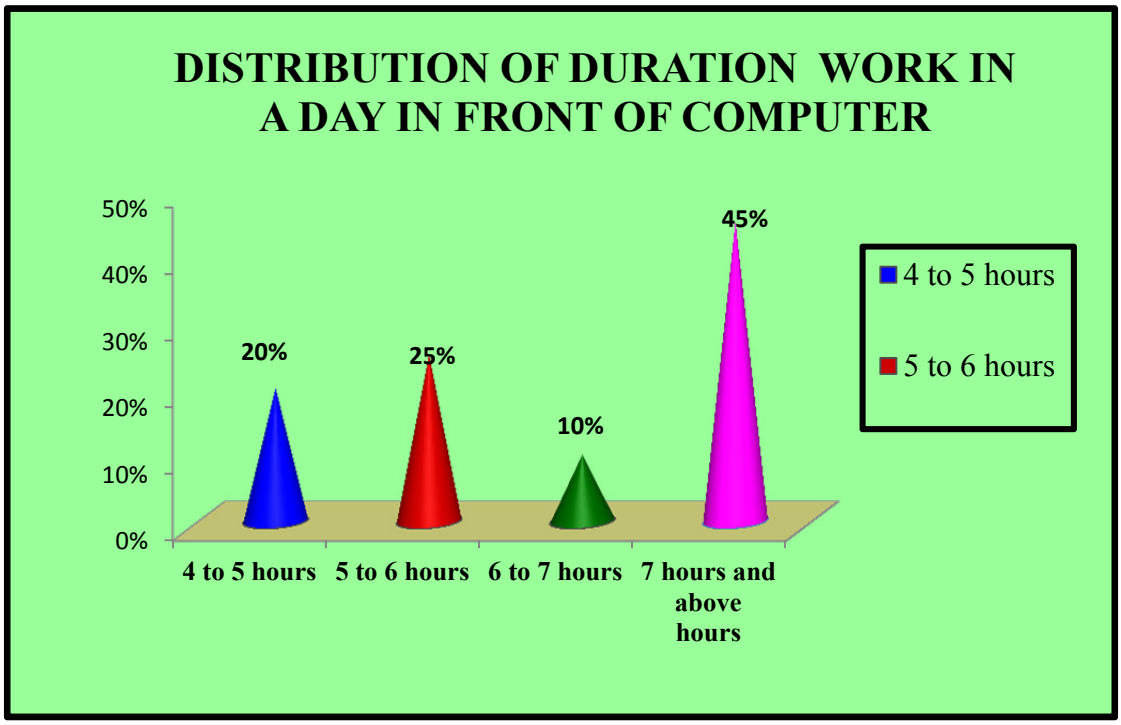


FIGURE 10: PERCENTAGE DISTRIBUTION ACCORDING TO THEIR DURATION OF WORK IN A DAY IN FRONT OF COMPUTER AMONG COMPUTER USERS

The above cone diagram represents, majority of computer users 45% were working y hours and above in a day in front of computer, 25% were working 5 to 6 hours in a day in front of computer, 20% were working 4 to 5 hours in a day in front of computer, 10% were working 6 to 7 hours in a day in front of computer

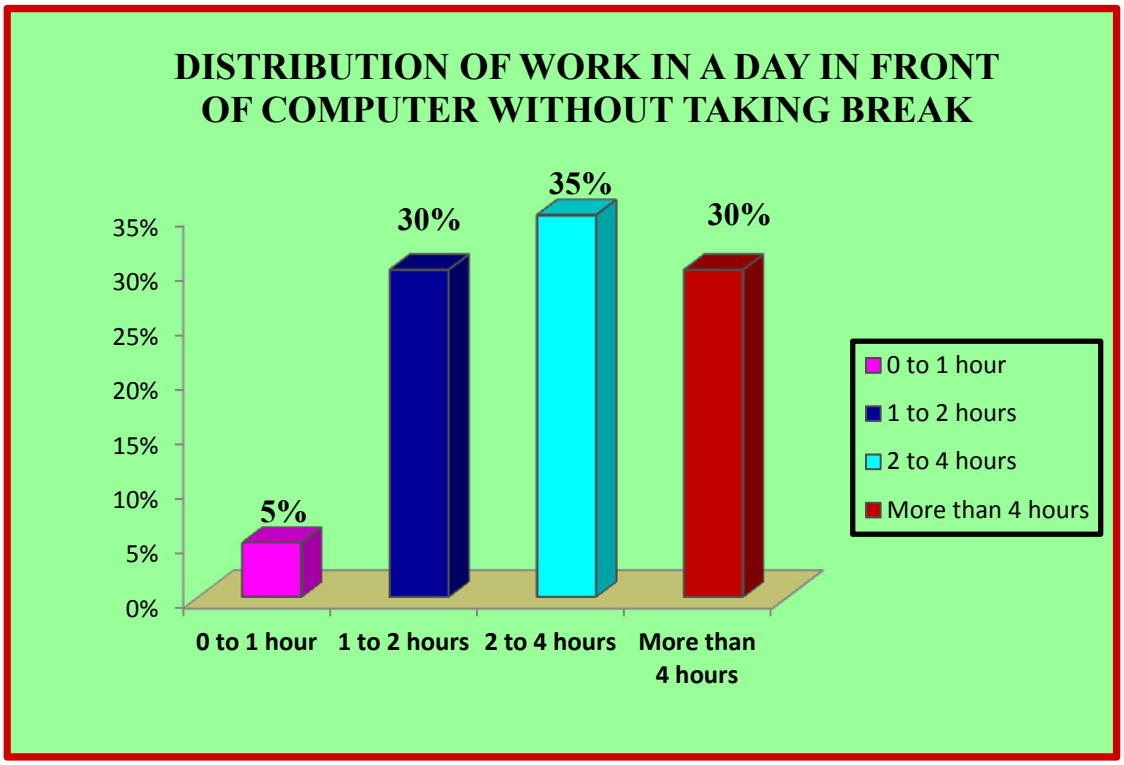


FIGURE 11: PERCETNAGE DISTRIBUTION ACCORDING TO THEIR DURATION OF WORK IN A DAY IN FRONT OF COMPUTER WITHOUT TAKING BREAK AMONG COMPUTER USERS

The above3D bar diagram represents, majority of computer users 35% were working 2 to 4 hours in front of computer without taking break, 30% were working more than 4 hours and 1 to 2 hours in front of computer without taking break, 5% were working 0 to 1 hour in front of computer without taking break.

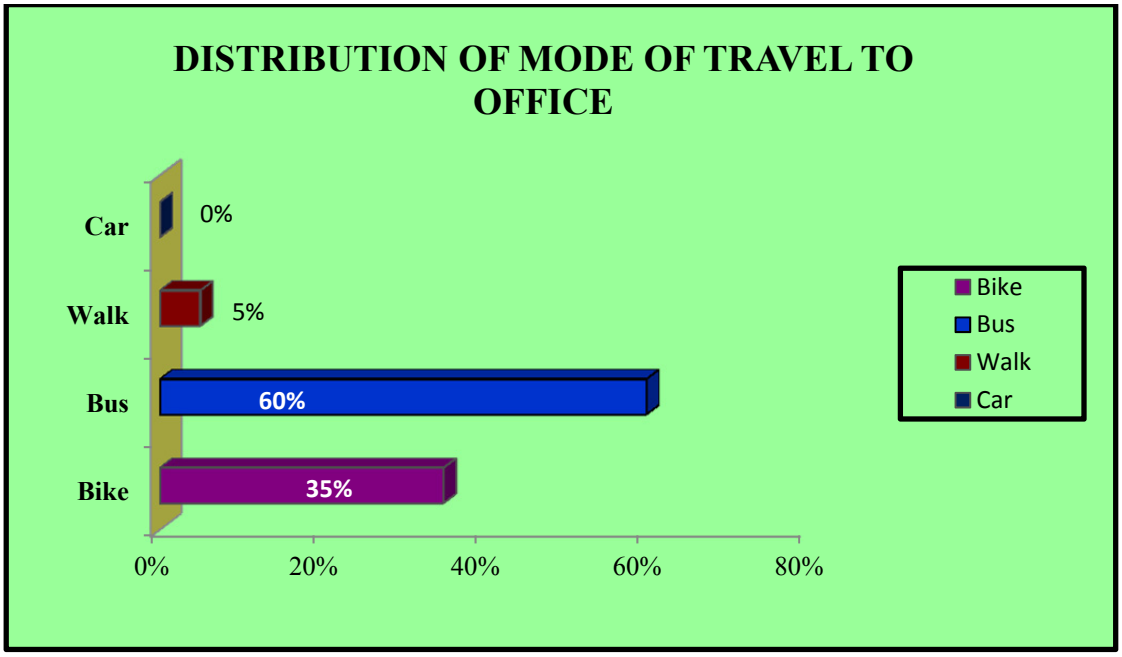


FIGURE 12: PERCENTAGE DISTRIBUTION ACCORDING TO THEIR MODE OF TRAVEL TO OFFICE AMONG COMPUTER USERS

The above 3D bar diagram represent, majority of computer users 60% were commuting by bus to office, 35% commuting by bike, 5% were commuting by walk.

SECTION –II

DISTRIBUTION OF LEVELS OF PHYSICAL DISCOMFORT AMONG COMPUTER USERS IN THE PRE TEST AND POST TEST

TABLE: 2

FREQUENCY AND PERCENTAGE DISTRIBUTION ON PRE TEST AND POST TEST LEVEL OF PHYSICAL DISCOMFORT AMONG COMPUTER USERS

LEVEL OF DISCOMFORT	PRE TEST		POST TEST		
	f	%		f	%
No risk injury	0	0%	No risk injury	34	85%
Some risk injury	22	55%	Some risk injury	6	15%
More risk injury	18	45%	More risk injury	0	0

The above table reveals that in Pre test (before ergonomic intervention) 22 (55%) had some risk of injury, 18 (45%) had more risk of injury, in Post test (after ergonomic intervention) level of physical discomfort was reduced and shown that 34 (85%) had no risk of injury, 6 (15%) had some risk of injury, and none of them were in more risk of injury.

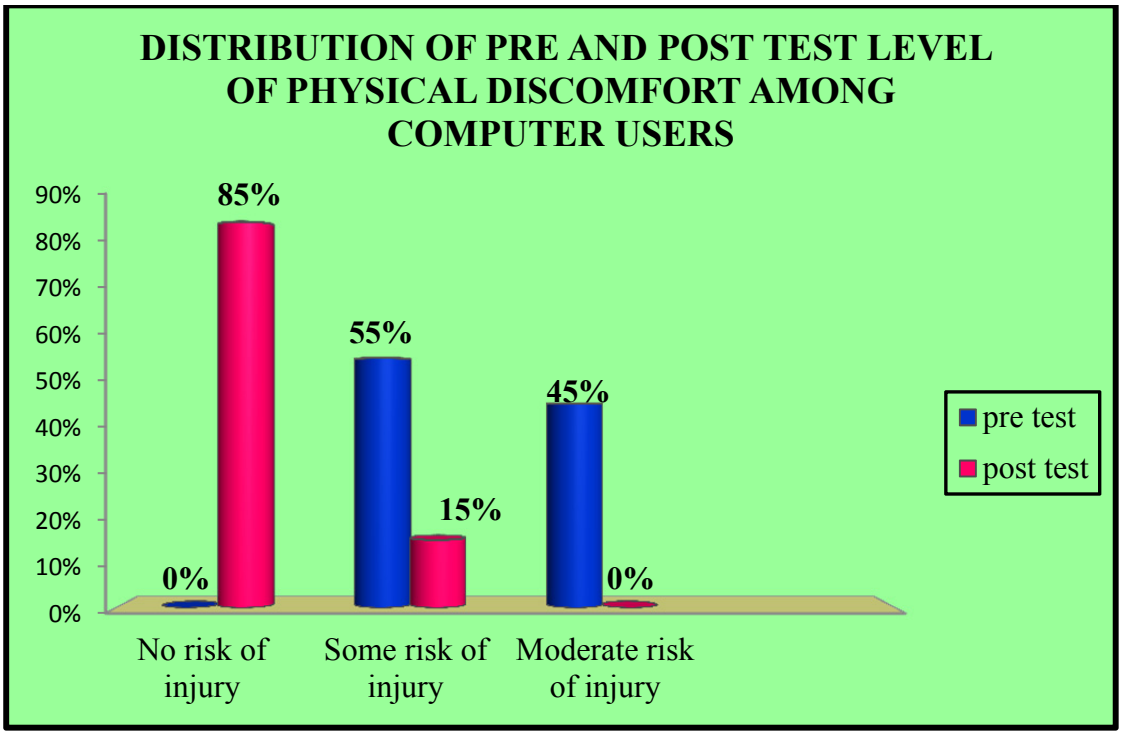


FIGURE 13: PECENTAGE DISTRIBUTION OF PRE TEST AND POST TEST LEVELS OF PHYSICAL DISCOMFORT AMONG COMPUTER USERS

The above cylindrical diagram reveals, In Pre test majority 22 (55%) had some risk of injury, 18 (45%) had more risk of injury and 0% had no risk of injury, In Post test majority34 (85%) had no risk of injury, 6 (15%) had some risk of injury, and none of them (0%) were in more risk of injury.

SECTION-III

EFFECTIVENESS OF ERGONOMICS ON PHYSICAL DISCOMFORT AMONG COMPUTER USERS

TABLE: 3

EFFECTIVENESS OF ERGONOMICS ON PHYSICAL DISCOMFORT AMONG COMPUTER USERS

Variable	Mean	Mean Difference	SD	't' value	P-value
Pre –Test	4.4	↓ 2.6	0.67	17.716	0.001***
Post-Test	1.8		0.98		

*p<0.05, significant and**p<0.001&***p0.001, highly significant

The above table explained that in Pre test (before ergonomic intervention) mean score of physical discomfort was 4.4 with standard deviation of 0.67. In Post test (after ergonomic intervention) mean score of physical discomfort was 1.8 with standard deviation of 0.98. The mean difference was 2.6. The calculated "t" test value was 17.716. This was higher than the table value at 0.001 level of significance with 39 degree of freedom. The mean score showed significant changes. Thus the inferential statistical method proved that the difference in the level of physical discomfort among computer users. Hence ergonomic intervention was effective in reducing the levels of physical discomfort among the computer users.

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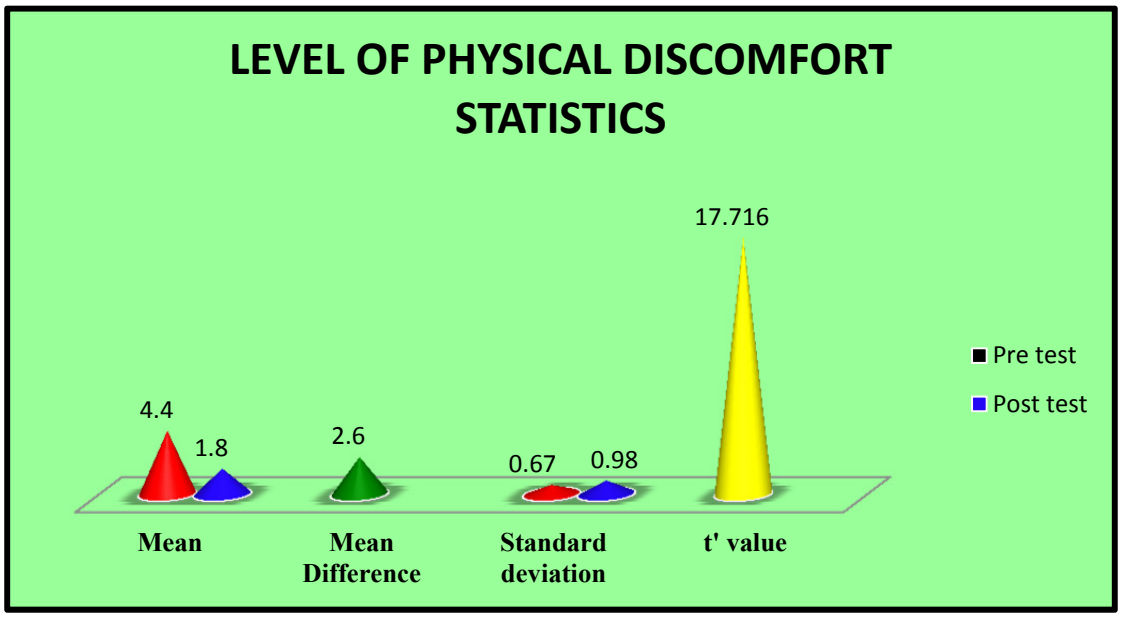

FIGURE: 14, DISTRIBUTION OF THE PRETEST AND POST TEST MEANS AND STANDARD DEVIATION AMONG COMPUTER USERS

The above cone diagram reveals, In Pre test (before ergonomic intervention) mean score of physical discomfort was 4.4 with standard deviation of 0.67. In Post test (after ergonomic intervention) mean score of physical discomfort was 1.8 with standard deviation of 0.98. The mean difference was 2.6. The calculated "t" test value was 17.716. This was higher than the table value at 0.001 level of significance with 39 degree of freedom.

SECTION IV

ASSOCIATION BETWEEN POST TEST LEVELS OF PHYSICAL DISCOMFORT AND SELECTED SOCIO DEMOGRAPHIC VARIABLES AMONG COMPUTER USERS

TABLE: 4

ASSOCIATION BETWEEN POST TEST LEVEL OF PHYSICAL DISCOMFORT AND SELECTED SOCIO DEMOGRAPHIC VARIABLES

VARIABLES		No risk of injury		Some risk of injury		$\chi 2$	p value
		f	%	f	%		
AGE	21-30 Years	28	70	4	10	0.789 (NS)	p > 0.05
	31-40Years	6	15	2	5		
	41-50 years	0	0	0	0		
SEX	Male	11	27.5	3	7.5	0.698 (NS)	p > 0.05
	Female	23	57.5	3	7.5		
EDUCATIONAL QUALIFICATION	Graduation	23	57.5	5	12.5	1.905 (NS)	p > 0.05
	Post graduation	8	20	0	0		
	Diploma	3	7.5	1	2.5		
NUMBER OF YEARS USING COMPUTER	<1	3	7.5	1	2.5	2.519 (NS)	p > 0.05
	1 to 5	23	57.5	3	7.5		
	5 to 10	7	17.5	1	2.5		
	11 and above	1	2.5	1	2.5		
RELIGION	Hindu	29	72.5	5	12.5	0.669 (NS)	p > 0.05
	Christian	3	7.5	1	2.5		
	Muslim	2	5	0	0		

SOURCE OF INFORMATION	Colleagues	0	0	0	0	0 (NS)	p > 0.05
	T.V and Internet	0	0	0	0		
	Books	0	0	0	0		
	Don't Know	34	85	6	15		
MONTHLY INCOME	Less than Rs.5000	0	0	0	0	0.015 (NS)	p > 0.05
	Rs.5001-Rs.10000	29	72.5	5	12.5		
	Rs.10001-Rs.20000	5	12.5	1	2.5		
	Rs.20001 and above	0	0	0	0		
DURATION OF WORK IN A DAY IN FRONT OF COMPUTER	4 to 5 hours	8	20	0	0	3.032 (NS)	p > 0.05
	5 to 6 hours	7	17.5	2	5		
	6 to 7 hours	4	10	0	0		
	7 hours and above	15	37.5	4	10		
WITHOUT TAKING BREAK, DURATION OF WORK IN FRONT OF COMPUTER	0 to 1 hour	2	5	0	0	4.516 (NS)	p > 0.05
	1 to 2 hours	12	30	0	0		
	2 to 4 hours	12	30	2	5		
	More than 4 hours	8	20	4	10		
MODE OF TRAVEL TO OFFICE	Bike	11	27.5	3	7.5	0.924 (NS)	p > 0.05
	Bus	21	52.5	3	7.5		
	Walk	2	5	0	0		
	Car	0	0	0	0		

*p<0.05, significant and**p<0.001&***p0.001, highly significant NS=Non Significant

The above table revealed that the calculated $\chi 2$ at 0.05 level of significance. It described the association of individual Socio demographic variable with level of physical discomfort among computer users after ergonomic intervention. It also explained that there were no significant association between post test level of

discomfort and selected socio demographic variable of computer users. The calculated $\chi 2$ value for the selected Socio demographic variables were lower than the table value at 0.05 level of significance, hence it concluded that selected socio demographic variable among computer users were not associated with the levels of physical discomfort.

Discussion

CHAPTER - V

DISCUSSION

Based on the objectives of the study and hypothesis, this chapter deals with the detailed discussion of the results of the data interpreted from the statistical analysis. The purpose of the study was to evaluate the effectiveness of ergonomics on physical discomfort among computer users at selected IT office in Madurai.

Advances in information and communication technology have promoted the use of computers by individuals for collecting, creating and transmitting information. The computer is thus becoming an essential feature for an individual's daily life. Working with computers for an extended period of time can cause damaged eyesight, bad posture, arthritis in fingers and computer stress injuries.

Occupational health aims at the promotion and maintenance of the highest degree of physical, mental, and social wellbeing of workers in all occupations. The specialty of occupational and environmental health nursing has always been closely linked to community health nursing. The application of ergonomics has made a significant contribution in reducing industrial accidents and to the overall health and efficiency of the workers

The computer operators and IT professionals face a tough time tackling the occupational health problems. Ocular discomfort, musculoskeletal disorders and psycho-social problems form the key categories of health problems found among constant computer users. These problems require a multidisciplinary action. Health education and training of personnel could form the back bone of the cure. Application of ergonomics and better technology are also essential. There is an immediate need to sensitize the management of the organizations employing computer professionals,

about these problems and enforce suitable measures to prevent the burn out of the employees.

The study was to evaluate the effectiveness of ergonomics on physical discomfort among computer users at selected IT office in Madurai. The sample consists of 40 computer users, selected by purposive sampling technique were adopted. Pre test was assessed by self administered method framed on base line data and Rapid Upper Limb Assessment scale is used to assess physical discomfort. The ergonomic intervention is given. Data analysis and interpretation were done by frequency, percentage, mean Standard deviation and Paired 't' test. The results of the study were discussed based on the objectives on following supportive studies.

BASE LINE VARIABLES OF COMPUTER USERS AT SELECTED IT OFFICE IN MADURAI.

The present study showed that the higher frequencies of 80% subjects were belongs to 21-30 years. Majority of 35% subjects were males Most of the subjects 70% had graduation. Majority of subjects 65% were using computer 1 to 5 years. Most of subjects 85% belong to Hindu religion. Majority of subjects (100%) were not received any information regarding ergonomics from any source.

Majority of subjects 85% were earning between Rs. 5001 – Rs. 10000. Most of the subjects (45%) were working in front of computer between 7 hours and above. Most of subjects 35% were working in front of computer without taking break. Majority of subjects were commuting by bike to office.

The study was consistent with the study conducted by Norashikin Mahmud, Dianna Theadora Kenny, Raemy Md Zein, and Siti Nurani Hassan (2011) to evaluate the effects of office ergonomics training, compared with no training, on musculoskeletal disorders among university-based office workers at University

Teknologi Malaysia. A cluster randomized controlled trial was used in this study. After ergonomics training , the result showed that a significant improvement in workstation habits was found. The results showed that the percentage of musculo skeletal disorders in the intervention groups was consistently reduced for all outcomes at the follow-up time point and ranged from −10.3% to −44.2%. The largest reduction percentage was for the neck region (−42.2%, 95% CI −60.0 to −24.4), followed by the left upper limb (−29.6%, 95% CI 46.31 to −12.89) and left lower limb (−28.1%, 95% CI −41.99 to −14.21).

The first objective of the study was to assess the level of physical discomforts among computer users at selected IT offices in Madurai.

In this study the physical discomforts among computer users were measured by RULA scale

The present study reveals that pre test score of Rapid Upper Limb Assessment (RULA) scale on physical discomfort 45% of subjects were having more risk of injury, 55% of subjects were having some risk of injury.

The present study was consistent with the study conducted by Pat Tittiranonda, PHD., Stephen Burastero, MD., David Rempel, MD., (2012) to assess the risk factors for musculoskeletal disorders among 150 newspaper employees at San Francisco. The study includes only employees from the editorial department. Randomized control trial design was used in this study. The result showed that the risk of an upper extremity disorder increased 1.49 times with increasing daily hours of computer use (95% CI = 1.10-2.02).

The another study finding also was consistent with the study conducted by Venkatesan Rajagopal, Rosmah Mohd Rosli, Pederlia Rintai, Nurani Rustim, Rita Benadus and Warni Usai, Department of Physiotherapy, (2011) to examine the

prevalence of musculoskeletal pain among 170 college students aged 19-27 years in the first through third years of their college study in selected colleges at Malaysia. A cross-sectional study was performed. Using random sampling, Physical Activity Questionnaire with informed consent were distributed to 200 college students. The mean age of the participants was 21.28. The result showed that out of 170 students, 145 students were females and 25 students were males. The numbers of students reported having musculoskeletal pain during or after computer use were 149 students (88%).

This study finding also dependable with the study conducted by Dr. Vijaya Shankargouda Dandannavar, Department of Physiology. (2010), to assess the motor performance in upper limb among regular computer users of Jawaharlal Nehru medical college, Belgaum. The result showed that 60 participants reported with musculoskeletal problems and that hand function decreases with increasing age. In that duration of computer usage years and hours of computer use per week was a significant decrease in the mean vale for both among males and females ($p>0.05$,).

The second objective of the study was to evaluate the effectiveness of ergonomics among computer users at selected IT office in Madurai.

Ergonomic intervention demonstrated to the computer users and the effectiveness was evaluated through post test. The finding reveals that pre and post test level, the pre test pre test level of physical discomfort 45% of subjects were having more risk of injury, 55% of subjects were having some risk of injury. After demonstration of ergonomic intervention the post test level of physical discomfort among computer users showed that there is decreased level of physical discomfort, 85% subjects were having no risk of injury, 15% subjects have some risk of injury.

There was significant difference in percentage of physical discomfort among computer users in post test.

The mean post test score of physical discomfort was 1.8 among subjects after ergonomic intervention was significantly lower than their mean pre test score of physical discomfort 4.4 .Thus the inferential statistical method proved that the difference in the mean scores showed a significant change as in the decrease level of physical discomfort among computer users. The calculated‘t’ value for physical discomfort 17.716 the p value 0.000*** -P<0.001, It shows highly significant. Thus the inferential statistical method proved that the difference in the mean scores showed significant change as decrease level of physical discomfort among computer users. Ergonomic intervention was effective in reducing the physical discomfort level among the computer users.

The present study was consistent with the study conducted by Yahya Rasoulzadeh1, Reza Gholamni, Department of Occupational Health Engineering, (2012) on Effectiveness of an Ergonomics Training Program on decreasing Work-Related Musculoskeletal Disorders Risk among Video Display Terminals Users. This study was conducted among a large group of computer users in SAPCO industrial company, Tehran, Iran (84 persons with 29.85±11.2 years of age and with 6.98±2.54 years of experience). An active ergonomics-training program was designed and implemented during 14days to empower the Video Display Terminal users and involve them in improving their workstations. The direct observational RULA (Rapid Upper Limb Assessment) method was used in pre and post intervention stages to evaluate the risk of Worked Related Musculoskeletal Disorders (WMSDs) among participants. The result showed that the Rapid Upper Limb Assessment (RULA) final scores showed that 18.8 % of VDT users were at action level 2, 63.5%at action level 3

and 17.6% at action level 4 before any intervention. In addition, 8.2% of users were at action level 1, 44.7% at action level 2, 42.4% at action level 3 and 4.7% at action level 4 at the post-intervention stage. The results of Wilcoxon statistical test indicated that RULA scores were decreased significantly after interventions ($P < 0.05$) and consequently, decreased risk of Work related musculoskeletal disorders.

One more study also consistent with the study conducted by Nuchrawee Jamjumrus (2010) on musculoskeletal discomforts induced by computer operations and ergonomic intervention to improve work posture when operating computer among 22 computer users in Thai office employee Bangkok. Twenty-two computer users (eleven males and eleven females) were asked to operate their computers according to their normal work practice. Photographs of their work postures were taken and analyzed using the Rapid Upper Limb Assessment (RULA) technique. The algorithms were then employed to determine recommended adjustments for their computers After implementing the necessary adjustments, the computer users were then re-seated at their workstations, photographs of their work postures were re-taken, and the posture analysis was performed again. The results show that the computer users' work postures are improved when their computers and workstations are adjusted according to the recommendations. The effectiveness of ergonomic intervention is verified both visually and objectively. The Rapid Upper Limb Assessment (RULA) analysis of before and after ergonomic intervention while working with computers of twenty-two subjects (11 male subjects – 11 female subjects). It is seen that the average Rapid Upper Limb Assessment (RULA) scores drop from 6.09 to 3.18 and from5.91 to 3.09 in the male and female groups, respectively. Decreased RULA scores observed in the work postures after ergonomic intervention clearly indicate that the adjustment algorithms are effective in helping to improve the computer users' work postures.

From paired *t*-tests, the differences of RULA scores between before and after ergonomic intervention are found to be significant for both male and female groups ($p < 0.0005$).

Hence, Hypothesis 1: The Mean post test score is significantly lower than the mean pre test score of Physical discomforts among the computer users -was accepted

The third objective was to determine the association between the levels of physical discomforts with their selected socio demographic variables.

In association of post test level of physical discomfort with selected socio demographic variables the study result shows that there was no significant association between post test level of physical discomfort with the age, sex, educational qualification, number of years of using computer, religion, source of information, monthly income, duration of work in a day in front of computer, duration of work in front of computer without taking break, mode of travel to office.

The present study reports was consistent with the study conducted by Sonal Devesh Lecturer in Mathematics, Nisreen Al-Bimani, QA Asst & Lecturer in IT (2011) on the effectiveness of a planned teaching programme to improve the knowledge regarding "ergonomics for computer use" among Selected staff of majan college at Muscat. A pre experimental research design was used to conduct the study. Thirty samples who met the study criteria were selected using convenience sampling technique. The knowledge level of the staff was assessed using a pretest questionnaire. The subjects were then exposed to a planned teaching programme. The teaching programme included power point presentation with multimedia clippings, demonstration of exercises regarding ergonomics of computer use. The post test questionnaire was administered to the staff, to determine whether there is a gain in

knowledge due to the exposure of the subjects to the teaching programme. The results of the experiment showed that there was an increase in the pretest (m=9.36, s=3.91) and the post test mean (m=15.99, s=3.09) scores. Paired "t" test, proved that there was a significant difference in the pre and the post test scores (t29 = 11.466) at 5% level of significance. The chi square test results showed no association between the pre-test level of knowledge and the selected demographic variables

The another study was also reliable with the study conducted by Mr Martin Varkey (2013) on assess the knowledge and self reported Practice of ergonomics among computer users in Selected offices in Mangalore with a view to develop an Information booklet. The descriptive survey approach has been used in view of accomplishing the main objectives of the study. The findings of the study revealed that majority of the subjects (73%) did not have any previous information about computer ergonomics. More than half of the subjects (54%) use computer for 7 and more hours of work. The most common symptoms reported were eye strain (60%), followed by back pain (40%). Of the total, 47% had satisfactory knowledge, 28% good knowledge, 19% poor knowledge, 4%very good knowledge and 2% had very poor knowledge in computer ergonomics. More than half of the subjects (55%) reported partially safe practice, 31% reported mostly safe practice, 14% reported totally unsafe practice and none reported totally safe practice. Also, a weak positive correlation was found between knowledge and self-reported practice of computer ergonomics among the office computer users($r=0.272$, $p<0.05$). The results of the present study showed that there was significant association between knowledge and gender ($p=0.04$) of the subjects. A significant association between self-reported practice of computer ergonomics with variables like gender, ($p=0.016$), was found out. However, other variables like age, education, years using computer, monthly

income, hours of work using computer and symptoms did not have any association with the knowledge score and practice scores.

In association of post test level of physical discomfort with selected socio demographic variables, the study result shows that there was no significant association between post test levels of physical discomfort among computer users. Hence it is proved that there is no significant association between post levels of physical discomforts with their selected demographic variables.

Thus the research **Hypothesis 2: there is a significant association between post test levels of physical discomforts with their selected socio demographic variables-was rejected.**

Summary, Conclusion & Recommendations

CHAPTER - VI

SUMMARY CONCLUSION AND RECOMMENDATIONS

This chapter deals with summary of the study, implications for Nursing Practice, Education, Nursing Research, Administration and recommendations for future research. "Effectiveness of Ergonomics on physical discomfort among computer users in selected IT office at Madurai."

6.1 SUMMARY

"Those who think they have not time for bodily exercise will sooner or later have to find time for illness"

-Edward Stantley

Computers have now become basic and essential desktop equipment in almost every establishment. Along with smaller size and affordable prices, there has been the advent of the Internet. With online training, trading and office work, the use of personal computers (PCs) is growing exponentially. In almost all offices, colleges, universities and homes today, the computers are becoming common place items. Computer related job opportunities are offering colorful salary and the wide nature of scope for this profession attracts many people into this field.

Before the dawn of the computer era, injuries and problems related to computer usage and Ergonomics were not that rampant.. Since early and mid-19 eighties the use of computer has increased dramatically. Nowadays, people rely so heavily on computers that you would hardly find a home or office without one or a dozen of them. Because of that, we see a significant rise in Carpal Tunnel Syndrome, back pains, eye discomforts, and any other computer injuries

Scientific studies have found various associations between computer use and illness, injury and discomfort of users. Many of those who use computers much of their workday indeed experience symptoms of general fatigue, eyestrain or irritation and physical discomfort. Computer ergonomic hazards are generally related to workstation setup, job design and work practices. .

It is known that personal computers usage, even for 3 hours per day, leads to a chance of injury or health risk including Occupational Overuse Syndrome, Computer Vision Syndrome, low back pain, tension headaches and psychosocial stress. Repetitive motion (such as keyboarding), poor posture and/or long job task duration increase the risk of pain and discomfort. Continued exposure to these hazards leads to Cumulative Trauma Disorders of the musculoskeletal system or what is commonly termed Repetitive Strain Injuries.

India being the forerunner in the cyber world the occupational health personals is slowly awakening to this group of modern occupational diseases, which are slowly taking its roots among the information technology (IT) professionals. These problems if ignored can prove debilitating and can cause crippling injuries forcing one to change one's profession. There is an urgent need to understand the dynamics of these problems and prevent it from assuming epidemic proportions. Ergonomics play a vital role in preventing computer related problems.

Ergonomics is the scientific study of human beings in relation to their work and effective use of human energy intended to maximize productivity by reducing operator fatigue and discomfort. When ergonomics is correctly used by the computer users, visual and musculoskeletal discomfort and fatigue are reduced significantly. Ergonomic intervention is one of the most effective ways of reducing muscle fatigue and the possibility of injury occurrence when using the computer. Ergonomic

exercises prepare our body for our next period of work, and Micro-breaks keep the body loose while using the computer. Most of the employees are not using appropriate ergonomics. This will lead to the development of musculoskeletal disorders.

Work-related health aspects should be considered as an integral part of comprehensive primary care. Specialized occupational health services, including the basic ones, should be further expanded and strengthened with more focus on primary prevention of occupational hazards. Close collaboration should be established between occupational health services and primary care teams under local networks for primary health care. Computer ergonomics aims to fit workplace conditions and job functions to the employee, thereby ensuring workers health and productivity.

Thus Ergonomics is important for IT professionals to have knowledge regarding ergonomic exercise and make use of it regularly while using computer to prevent physical discomfort. In this study to assess the level of physical discomfort among computer users and to taught the ergonomic intervention through demonstration, to reduce the level of physical discomfort and improve the knowledge, attitude and to make confident to practice ergonomic in their office set up.

The objectives of the study were

1. To assess the level of physical discomforts among computer users at selected IT offices in Madurai.
2. To evaluate the effectiveness of ergonomics among computer users at selected IT office in Madurai.
3. To determine the association between the level of physical discomfort with their selected socio demographic variables.

The following hypothesis were tested

H_1 - The Mean post test score is significantly lower than the mean pre test score of Physical discomforts among the computer users.

H_2 - There is a significant association between the levels of physical discomforts with their selected socio demographic variables.

The review of literature enabled the investigator to develop conceptual frame work, tool and methodology for the study. Literature review was done as follows, studies related to ergonomics in various occupational settings, studies related to ergonomics in office, studies related to prevalence of physical discomforts among computer users, studies related to effects of ergonomics on physical discomfort among computer users.

The conceptual framework for this study was based on Daniel L. Stufflebeam **(1960)** modified CIPP model. A pre experimental one group pre test post test design was used in this study. The independent variable was ergonomics and dependent variables were on Physical Discomfort. This model helped the investigator and approaching the problem in a comprehensive and systematic manner.

The methodology used for this study was quantitative approach Pre Experimental design - One group Pre test and post test design. A sample size of 40 computer users who had physical discomfort in a selected IT office (Great Minds Business Solution India Ltd) at Madurai, those who have met fulfilled the inclusion criteria. Non Probability purposive sampling technique was used to collect the samples. The tool used for this study was RULA (Rapid Upper Limb Assessment) scale on physical discomfort RULA scale is a postural targeting method for estimating the risks of work-related discomforts. A RULA assessment gives a quick and systematic assessment of the postural risks to a worker. The tool was tested for the

content validity and reliability prior to the study. Subsequently, pilot study was conducted in the non study setting and found that the study setting was feasible and practicable.

The data collection was done for a period of 4 weeks from 12/08/2014 - 15/09/2014. The data was collected on all the days including Sundays, permission to conduct the study was obtained from the Administrative Director of Great minds Business Solution India Ltd, Madurai.. The investigator visited the IT office and selected the clients on the basis of inclusion criteria. The purpose of the study was informed to the subjects; consent obtained from subjects, confidentiality was assured. The self administrated method was used to collect the baseline variables. Then the pre test was conducted by observation method with the use of RULA (Rapid Upper Limb Assessment) scale on level of physical discomfort. Subjects were divided into 4 groups that are 10 members in each group. Each group has session of 2 hours daily for demonstration of ergonomic intervention on physical discomfort including introduction. Ergonomic intervention was given to 40 subjects for 28 consecutive days. Subjects were encouraged to redemonstrate Ergonomic intervention. Subjects were observed while practicing ergonomic intervention daily. After ergonomic intervention the post test was conducted on 29^{th} and 30^{th} day. Totally 40 subjects were taken during the data collection periods. The subjects selected for pilot study were excluded in the main study. The collected data were entered in data sheet and it is analyzed and interpreted in terms of the objectives using descriptive and inferential statistics.

6.2 MAJOR FINDINGS OF THE STUDY

- Most of the computer users comes under the two major age groups such as 80% were belongs to 21-30 years, 20 % were belongs to 31 -40 years.
- Majority of the computer users 65% were females.
- The prime part of the computer users 70% had their educational qualification upto graduation and slightest 10% were had their educational qualification upto diploma.
- For the most part of the computer users 65% were using computers 1 to 5 years and least 5% were using computers more than 10 years.
- Majority of the computer users 85% were belongs to Hindu religion.
- Almost 100% of computer users were not received information regarding ergonomics from any source.
- Most of the computer users 85% were earn between Rs.5001-Rs.10000 and none of them were earn Rs. 20000 and above.
- Nearly half of the computer users 45% were working in front of computers in 7 hours and above.
- Most of the computer users 35% were working in front of computer between 2 to 4 hours without taking break.
- Majority of the computer users 35% were commuting by bike to office and least 5% were commuting by walk.
- Pre test of level of physical discomfort reveals that 55% had some risk injury, 45% had more risk injury,
- Post test level of physical discomfort reveals that there is 85% had no risk of injury,15% had some risk of injury, and none of them were in moderate risk of injury.

- The present study reveals that the mean post test score of physical discomfort among computer users after ergonomic intervention will be significantly lower than their mean pre test score of physical discomfort. The inferential statistical method proved that the difference in the mean scores showed a significant change as decrease level of physical discomfort among computer users. Thus ergonomic intervention was effective in decrease the level of physical discomfort among computer users.
- In association of post test level of physical discomfort with individual Socio demographic variables the study shows that there was no significant association between post test level of discomfort and selected socio demographic variable of computer users.

6.3 CONCLUSION

Computer use is widespread in workplace and at home, with up to 25% of people reported to use a computer for more than 50% of their working day. Since computer related health problems like head ache, vision discomfort, shoulder pain, back pain and wrist pain is more common in IT professionals when compared to other working situations, ergonomic intervention will be effective in reducing the possibility of occurrence of such health problems. As Community health nurses working in public health and industries can effectively guide computer users for the early diagnosis of physical discomfort and teach ergonomic intervention to prevent musculoskeletal disorders due to computer use. On evaluation, ergonomics among computer users decrease the physical discomfort. Ergonomics is an easy and inexpensive way compared to other treatment options. The findings of the study revealed that ergonomics on physical discomfort was effective on decrease the level of physical discomfort among computer users. After ergonomic intervention,

everyone in the office was using ergonomic intervention while operating computer. The computer users were now aware about their posture while working in computer and they sure about the cause of physical discomfort and its preventive measures.

6.4 NURSING IMPLICATIONS

NURSING SERVICE

- Nurses have the roles and responsibilities for all health-related aspects of peoples' life, including early recognition of occupational and work-related ill health, as well as preserving and restoring working capacity of individuals. Nurse can work on health aspects of computer users through observation and assessment of both the computer worker and the office environment and make interpretations and evaluations based on the assessment.
- Ergonomic Intervention can be practiced as a routine work with a computer use
- The community health nurse should know the work pattern, work related physical discomfort and health problems of office employers and encouraged them to adopt the safe work style and healthy life style practices such as ergonomics
- Ergonomics to be taught to computer users in colleges and offices.
- In the community setting , Nursing interventions include organizing awareness programs on computer ergonomics, conducting ergonomic training programs, periodic health checkups, identifying computer users risk exposure and documentation of the services.

NURSING EDUCATION

- Nurses who are working in community area should be expected to have thorough knowledge in observe and assess the workers health status with respect to job tasks and hazards and identification of high risks office workers and quick assessment skills.
- General information about the office workers health specific issues and problems related to computer use to be included in nursing curriculum
- Conduct periodic in service education to the health personnel working in community
- Organize workshops and hands on training for health personnel working in the community regarding Ergonomic practices.
- Computer is now an inevitable equipment for any occupation, nurses who focus on worker's health should be aware of the computer ergonomic principles for the workers there by equipping them for primary prevention through awareness programs and training.
- Though computer education is a part of nursing curriculum there is no much emphasis on computer related physical problems and preventive measures. Nurse as an educator needs to learn and disseminate the information on computer related health problems especially highlighting on physical problems and preventive measures to the computer workers
- Periodicals can be published on the newer paradigm of worker's health services issues in computer related health problems early detection methods to the community

NURSING ADMNISTRATION

- The nurse administrator should give attention in proper selection, placement and effective utilization of nurses in all access within the available resources giving importance for their creativity, internal ability in education.
- Nurse as an administrator can influence the quality of nursing in any organization by planning different health education programs and in-service education programs and supervising care in different levels.
- Nurse administrator could co-ordinate and conducts various educational programs on computer related health problems with other health care personnel, software professionals and other computer users at various settings by creating awareness in order to prevent the epidemic problem of computer related health problems
- Develop comprehensive strategy and policy for active utilization of computer users and office workers
- Nursing administrators should be capable of making policies and decisions for meeting the changing needs of the stakeholders (employee, employer and society).
- Nursing administrators should take initiatives in training and specializing nurses in occupational health aspects and computer ergonomics.
- Ensure that the government health care facilities should have proper infrastructure, service personnel and quality of health services made available to the population.
- Budgetary allocation could be hiked for differential funding pattern based on the need for workers health issues.

NURSING RESEARCH

- The generalization of the study result can be made by replication of the study.
- Disseminate the findings through conferences, seminars, publication in journals and World Wide Web.
- The researcher can encourage to use other teaching modules on Ergonomics
- The findings of the study can help to expand the scientific body of professional knowledge upon which further research can be conducted. It will in turn strengthen nursing research pertaining clinical nursing
- This study directs the nursing personnel's to broaden and expand their knowledge and skill to elicit problems and to conduct various researches to improve their power to implement prompt activities.
- Develop network for new directions in research and collaboration in utilizing occupational health services in India.
- Nurses and nursing students should undertake more research activities in workers' health problems and issues in India.

6.5 RECOMMEDATIONS

- To issue the print bills, poster, pamphlet regarding ergonomics.
- To provide more awareness on work related physical discomfort and work related musculoskeletal disorders.
- To provide the information regarding the prevention of physical discomfort among office workers through radios and television
- Similar study can be conducted with the large samples in IT office.
- The study can be conducted in other setting like industries.
- The study can be conducted as a true experimental design and as comparative study with other instructional modules.

- ❖ A descriptive study can be also conducted to evaluate the physical discomfort, knowledge regarding ergonomics among computer users.

6.6 LIMITATION

- ➢ Since the study was in office set up, to demonstrate ergonomics at a time for all subjects, it is difficult to change their duty schedule, so the researcher divided the subjects into 4 groups and demonstration of ergonomic intervention to the subjects in session basis.
- ➢ Assessment takes more time because of observation method

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Appendices

APPENDIX – I

PERMISSION LETTER

From

Ms.Thennarasi.M,
I year M.Sc Nursing,
College of Nursing,
Madurai Medical College,
Madurai.

TO

Mr. Vigneshraj.R,
Director,
Greatminds India Business Solution India Ltd,
288, Sornathiru Towers,
2nd East Cross St,
Madurai – 20.

Through The Proper Channel.

Respected sir,

Sub: Permission for conducting dissertation study at Greatminds ~~India~~ Business Solution India Ltd, Madurai - II Year M.sc (N) Community health Nursing Student- College of Nursing, Madurai Medical College, Madurai – requested- Regarding.

As per the curriculum recommended by the Tamil Nadu Dr.M.G.R. Medical University, I have selected the topic**" A Study to assess the Effectiveness of Ergonomics among computer users at selected IT office- Great Minds ~~Indi~~ Business Solution India Ltd in Madurai"** for the partial fulfillment of the PG course.

I kindly request you to consider my letter and allow me to conduct the study in your esteemed institution.

Thanking You,

Date : 11.6.2014

Place : Madurai

Yours faithfully,

(THENNARASI.M)

Forwarded
S.P
11/6/14
Principal
COLLEGE OF NURSING
Madurai Medical College
Madurai-20.

Permission Granted.

For GREATMINDS BUSINESS SOLUTIONS INDIA LTD,

DIRECTOR

APPENDIX – II

ETHICAL COMMITTEE APPROVAL LETTER

Ref. No. 68/E4/2/2014,

Govt. Rajaji Hospital,
Madurai.20. Dated:26.02.2014

Institutional Review Board / Independent Ethics Committee.
Capt. Dr.B. Santhakumar, M.D., (F.M.,) deanmdu@gmail.com
Dean, Madurai Medical College &
Govt Rajaji Hospital, Madurai 625020. **Convenor**

Sub: Establishment-Govt. Rajaji Hospital, Madurai-20-
Ethics committee-Meeting Minutes- for February 2014
Approved list - Regarding.

The Ethics Committee meeting of the Govt. Rajaji Hospital, Madurai was held on 07.02.2014, Friday at 10.00 am to 12.00.noon at the Anaesthesia Seminar Hall, Govt. Rajaji Hospital, Madurai. The following members of the committee have attended the meeting.

1.Dr.V. Nagarajan, M.D., D.M (Neuro) Ph: 0452-2629629 Cell.No 9843052029 nag9999@gmail.com	Professor of Neurology (Retired) D.No.72, Vakkil New Street, Simmakkal, Madurai -1	Chairman
2. Dr.Mohan Prasad , M.S M.Ch Cell.No.9843050822 (Oncology) drbkcmp@gmail.com	Professor & H.O.D of Surgical Oncology(Retired) D.No.32, West Avani Moola Street, Madurai -1	Member Secretary
3. Dr. Parameswari M.D (Pharmacology) Cell.No.9994026056 drparameswari@yahoo.com	Director of Pharmacology Madurai Medical College	Member
4. Dr.S. Vadivel Murugan, MD., (Gen.Medicine) Cell.No 9566543048 svadivelmurugan_2007@rediffmail.com	Professor& H.O.D of Medicine Madurai Medical College	Member
5. Dr.S. Meenakshi Sundaram, MS (Gen.Surgery) Cell.No 9842138031 drsundarms@gmail.com	Professor & H.O.D of Surgery Madurai Medical College	Member
6. Mrs. Mercy Immaculate Rubalatha, M.A., Med., Cell. No. 9367792650 lathadevadoss86@gmail.com	50/5, Corporation Officer's quarters, Gandhi Museum Road, Thamukam, Madurai-20	Member
7. Thiru..Pala. .Ramasamy , BA.,B.L., Cell.No 9842165127 palaramasamy2011@gmail.com	Advocate, D.No.72.Palam Station Road, Sellur, Madurai -2	Member
8. Thiru. P.K.M. Chelliah ,B.A Cell.No 9894349599 pkmandco@gmail.com	Businessman, 21 Jawahar Street, Gandhi Nagar, Madurai-20	Member

The following Projects was approved by the committee.

Name of P.G.	Course	Name of the Project	Remarks
M. Thennarasi	M.Sc., (Nursing) College of Nursing, Madurai Medical College, Madurai.	A study to assess the effectiveness of Ergonomics among computer users at selected Information Technology Office-Great Minds India Business Solution India Ltd in Madurai.	Approved

Please note that the investigator should adhere the following: She/He should get a detailed informed consent from the patients/participants and maintain it Confidentially.

1. She/He should carry out the work without detrimental to regular activities as well as without extra expenditure to the institution or to Government.

2. She/He should inform the institution Ethical Committee, in case of any change of study procedure, site and investigation or guide.

3. She/He should not deviate the area of the work for which applied for Ethical clearance.

She/He should inform the IEC immediately, in case of any adverse events or Serious adverse reactions.

4. She/He should abide to the rules and regulations of the institution.

5. She/He should complete the work within the specific period and if any

Extension of time is required He/She should apply for permission again and do the work.

6. She/He should submit the summary of the work to the Ethical Committee on Completion of the work.

7. She/He should not claim any funds from the institution while doing the work or on completion.

8. She/He should understand that the members of IEC have the right to monitor the work with prior intimation.

Member Secretary **Chairman**
Ethical Committee

26.2.14 **DEAN/Convenor**
Govt. Rajaji Hospital,
Madurai- 20.

24/2/14.

To
The above Applicant
-thro. Head of the Department concerned

APPENDIX – III

CONTENT VALIDITY CERTIFICATES

This is to certify that the tool

SECTION A- Demographic Data

SECTION B- RULA scale

Prepared for data collection by Ms Thennarasi.M, II year M.sc (N) student, College of Nursing, Madurai Medical College, Madurai, who has undertaken the study field on thesis entitled **"A STUDY TO EVALUATE THE EFFECTIVENESS OF ERGONOMICS ON PHYSICAL DISCOMFORTS AMONG COMPUTER USERS IN SELECTED IT OFFICE AT MADURAI."** has been validated by me.

SIGNATURE OF THE EXPERT 7/8/14

NAME:

DESIGNATION:

ADDRESS:

DATE:

DIRECTOR
INSTITUTE OF COMMUNITY ME
MADURAI MEDICAL COL
MADURAI.

CERTIFICATE OF VALIDATION

This is to certify that the tool

SECTION A- Demographic Data

SECTION B- RULA scale

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SIGNATURE OF THE EXPERT 12/8/14

NAME: Dr. Juliet Sylvia, M.Sc (N), Ph.D.,

DESIGNATION: Professor, Head of the Department. Community health Nursing

ADDRESS: ultra college,

DATE:

CERTIFICATE OF VALIDATION

This is to certify that the tool

SECTION A- Demographic Data

SECTION B- RULA scale

Prepared for data collection by Ms Thennarasi.M, II year M.sc (N) student, College of Nursing, Madurai Medical College, Madurai, who has undertaken the study field on thesis entitled **"A STUDY TO EVALUATE THE EFFECTIVENESS OF ERGONOMICS ON PHYSICAL DISCOMFORTS AMONG COMPUTER USERS IN SELECTED IT OFFICE AT MADURAI."**has been validated by me.

SIGNATURE OF THE EXPERT

NAME: Mr. D. JOHN SAM ARUN PRABU
M.Sc(N), M.Sc(Psy), M.Phil (Psy), PhD.,

DESIGNATION: Professor,

ADDRESS: C.S.I. Jeyaraj Annapackiam College of Nursing, & Allied Sciences, Panimalar, Madurai - 625004.

DATE:

CERTIFICATE OF VALIDATION

This is to certify that the tool

SECTION A- Demographic Data

SECTION B- RULA scale

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SIGNATURE OF THE EXPERT

NAME: VEMBU.K M.Sc (N),

DESIGNATION: FACULTY IN NURSING.

ADDRESS: COLLEGE OF NURSING, JIPMER.

DATE:

CERTIFICATE OF VALIDATION

This is to certify that the tool

SECTION A- Demographic Data

SECTION B- RULA scale

Prepared for data collection by Ms Thennarasi.M, II year M.sc (N) student, College of Nursing, Madurai Medical College, Madurai, who has undertaken the study field on thesis entitled**"A STUDY TO EVALUATE THE EFFECTIVENESS OF ERGONOMICS ON PHYSICAL DISCOMFORTS AMONG COMPUTER USERS IN SELECTED IT OFFICE AT MADURAI."** has been validated by me.

A. Gomathi

SIGNATURE OF THE EXPERT

NAME: GOMATHI.A.

DESIGNATION: Lecturer.

ADDRESS: College of Nursing

DATE:

JAWAHARLAL INSTITUTE OF POSTGRADUATE MEDICAL EDUCATION & RESEARCH
VERITAS CURAT
सत्यं महादेवजगत
PUDUCHERRY
College of Nursing

CERTIFICATE OF VALIDATION

This is to certify that the tool

SECTION A- Demographic Data

SECTION B- RULA scale

Prepared for data collection by Ms Thennarasi.M, II year M.sc (N) student, College of Nursing, Madurai Medical College, Madurai, who has undertaken the study field on thesis entitled **"A STUDY TO EVALUATE THE EFFECTIVENESS OF ERGONOMICS ON PHYSICAL DISCOMFORTS AMONG COMPUTER USERS IN SELECTED IT OFFICE AT MADURAI."** has been validated by me.

D. Gnanima 25/7/14

SIGNATURE OF THE EXPERT

NAME: D.G.ANIMA M.P.T.,

DESIGNATION: ASST. PROF

ADDRESS: TRINITY MISSION & MEDICAL FOUNDATION
COLLEGE OF PHYSIOTHERAPY
ULTRA TRUST
MADURAI - 625020

DATE:

APPENDIX- IV

INFORMED CONSENT FORM

I have been informed about the procedures and the purpose of the study. I have understood that I have the right to refuse my consent or withdraw it any time during the study without adversely affecting my duty. I am aware that being subjected to this study, I have to give my time for assessments and procedures and these assessments do not interfere with the benefits.

I, _____ , the under signed, give my consent to be a participant of this investigations/ study program/ clinical trial.

Signature of Subjects
(Name and address)

Signature of the investigator

APPENDIX - V

SECTION A

DEMOGRAPHIC DATA

Instructions: please read the following and please put a (□) mark in the appropriate column.

1. Age in years
    a. 21-30 [ ]
    b. 31-40 [ ]
    c. 41-50 [ ]
    d. 51 and above [ ]
2. Gender
    a. Male [ ]
    b. Female [ ]
3. Educational qualifications
    a. Graduation [ ]
    b. Post graduate and above [ ]
    c. Any other, specify_____
4. Number of years using the computer
    a. < 1 [ ]
    b. 1 to 5 [ ]
    c. 5-10 [ ]
    d. 11 and above [ ]
5. Religion
    a. Hindu [ ]
    b. Christian [ ]
    c. Muslim [ ]
6. Source of information
    a. Colleagues [ ]
    b. Television and internet [ ]
    c. Books [ ]
    d. Don’t Know [ ]

7. Monthly income (In Rupees)

a. Less than 5000 [ ]

b. 5001-10000 [ ]

c. 10001-20000 [ ]

d. 20001 and above [ ]

8. On an average, how many hours do you work in a day in front of computer?

a. 4 to 5 [ ]

b. 5 to 6 [ ]

c. 6 to 7 [ ]

d. 7 and above [ ]

9. Without taking a break, how long do you work in front of the computer?

a. 0 to 1 hour [ ]

b. 1 to 2 hour [ ]

c. 2 to 4 hour [ ]

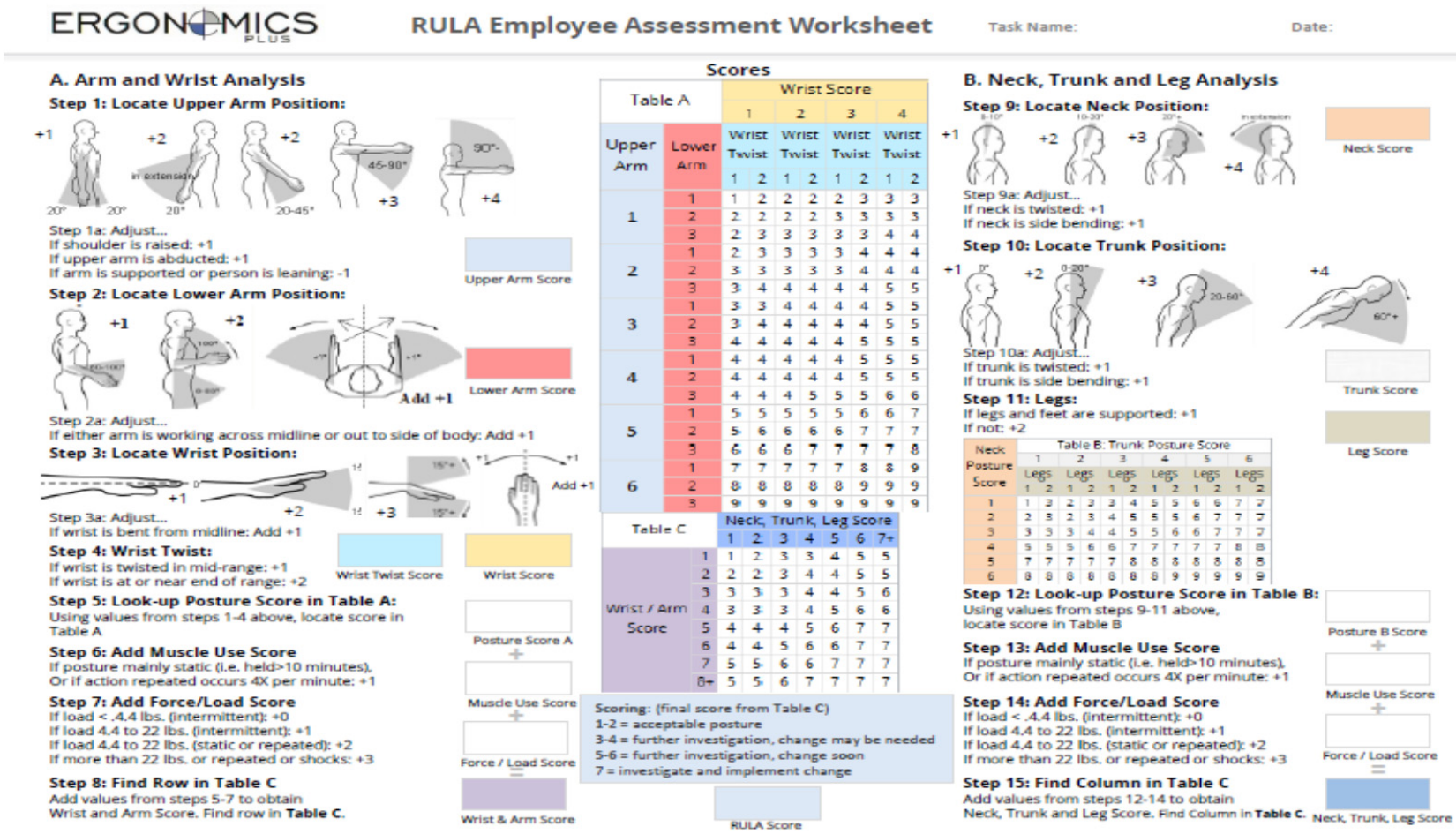
d. More than 4 hours [ ]

10. Mode of travel to office

a. Bike [ ]
b. Bus [ ]
c. Walk [ ]
d. Car [ ]

SECTION B

RULA (Rapid Upper Limb Assessment) Scale



Scoring procedure

RULA is a postural targeting method for estimating the risks of work-related discomforts. A RULA assessment gives a quick and systematic assessment of the postural risks to a worker. Scores were calculated by summing the scores for the given items.

Interpretation

The scores of each respondent over the scales are then evaluated as per the severity rating index below.

- **No risk of injury : 1 - 2**
- **Some risk of Injury : 3 - 4**
- **More risk of Injury : 5 – 6**
- **Severe risk of Injury : 7**

APPENDIX - VI

CERTIFICATE OF ENGLISH EDITING

TO WHOM SO EVER IT MAY CONCERN

This is to certify that the dissertation **"A study to evaluate the Effectiveness of Ergonomics on physical discomforts among computer users in selected IT office at Madurai."** done by Ms.Thennarasi.M, M.Sc., Nursing II year student, College of Nursing, Madurai Medical College, Madurai - 20 has been edited for English language appropriateness.

Name: D. MARGRET GREY CELIA.

Designation: P.G. ASST HEADMISTRESS. (ENGLISH)

Institution: T.E.L.C. G.H.S.S. USILAMPATTI

Signature

D. MARGRET GREY CELIA
M.A., M.Ed., M.Phil.,
Asst. Head Mistress
T.E.L.C. Girls Hr. Sec. School
Usilampatti. Madurai (Dt).

APPENDIX – VII
ERGONOMICS

Definition

Ergonomics refers to the demonstration of using right method of body parts and stretching exercise to the computer users to identify and prevent risk of injury that cause physical discomfort. Further it helps to increase the productivity of the employees and reduces the discomfort.

Principles of Ergonomics

1. **Work in Neutral Postures**
    - Maintain the "S-curve" of the spine: Your spinal column is shaped more or less like an "S." It is important to maintain the natural S-curve of the back, whether sitting or standing.
    - Keep the neck aligned: The neck bones are part of the spinal column and thus are subject to the same requirements of maintaining the S-curve. Prolonged twisted and bent postures of the neck can be as stressful as its equivalent for the lower back. The best way to make changes is usually to adjust equipment so that your neck is in its neutral posture.
    - Keeps elbows at sides: The neutral posture for your arms is to keep you elbows at your sides and your shoulders relaxed.
    - Keep Wrists in Neutral: There are several good ways to think about wrist posture. One way is to keep the hand in the same plane as the forearm,
2. **Reduce Excessive Force**
3. **Keep Everything in Easy Reach:** It deals with keeping things within easy reach. In many ways, this principle is redundant with posture, but it helps to evaluate a task from this specific perspective.
    - Reach Envelope: This is the semi-circle that your arms make as you reach out. Things that you use frequently should ideally be within the reach envelope of your full arm. Things that you use extremely frequently should be within the reach envelope of your forearms.

4. **Work at Proper Heights:** Working at the right height is also a way to make things easier.
    - Do most work at elbow height:A good rule of thumb is that most work should be done at about elbow height, whether sitting or standing.
5. **Reduce Excessive Motions:** the number of motions you make throughout a day, whether with your fingers, your wrists, your arms, or your back.
6. **Minimize Fatigue and Static Load:** Holding the same position for a period of time is known as static load. It creates fatigue and discomfort and can interfere with work.
7. **Minimize Pressure Points**
8. **Provide Clearance**
9. **Move, Exercise, and Stretch:** To be healthy the human body needs to be exercised and stretched.
10. **Maintain a Comfortable Environment:** This principle is more or less a catch-all that can mean different things depending upon the nature of the types of operations that you do.

Do's and Don'ts for Ergonomic Stretching Exercise

DO NOT

- Bounce, or use jerky motions
- Stretch till it hurts

DO

- Breathe deeply and relax
- Extend till you feel comfortable stretch
- Move smoothly and slowly.

ERGONOMIC TECHNIQUE FOR COMPUTER USERS

1. **COMPUTER WORKSTATION**

Computer workstation is the environment around your computer which includes furniture, computer equipment (Computer, monitor, Keyboard, and mouse), accessories (document holder, footrest, telephone, palm rest) and ambient factors (noise, lighting, temperature, etc,).

Re-organize your work space by moving all necessary equipment and supplies close, to no more than an arm's length away, or to a location where you must get up and walk to it. It's important to be aware of how the design and arrangement of your equipment can impact your comfort, health and productivity.

2. MONITOR

- The screen should be located directly in front of you so there is no twisting of your head or neck).
- The top line of screen should at or slightly (0-30 degrees) below eye level, and located at least arm's length away from you.
- You should be able to clearly read the screen without bending your head, neck or trunk forward/backward.
- The monitor should be in a location that eliminates glare on the screen which might cause you to assume an awkward posture to read screen.
- The monitor should be placed at a right angle and/or away from windows and task lights to avoid glare and bright light directly behind the screen.

For Bifocal users

Lower the monitor so you can maintain appropriate neck postures. Tilt the monitor screen up toward you if needed. Raise the chair height until you can view the monitor without tilting your head back. Use a pair of single-vision lenses with a focal length designed for computer work. Indirect glare on the computer screen caused by light directed onto the screen, which was then reflected to the eyes.

Methods for controlling glare:

- Tilt or move your screen so that it does not reflect light sources
- Position your desk so that light sources, such as windows, are perpendicular to the monitor rather than directly behind you or the monitor
- Adjust brightness and contrast on your display terminal
- Keep monitor dust free to make the screen free of glare

Ergonomic Stretching Exercise for EYES

- Every 20 minutes working at the screen, look out the window at a distant object for 10 seconds.
- Place a picture of rolling hills or a forest (picture has to be mostly green) and rest your eyes by staring at it for a while.
- Use these eye relaxing pictures, print them out at your computer or get them printed at a photo developing centre. You may share these pictures, as long as you link back to us!
- Blink Frequently
- Exercise your eye muscles once every hour, (close your eyes from time to time) periodically look at objects in the distance.
- After every 30 minutes of continuous computer use, pause to perform a few office exercises. It's important to take shorter breaks (every 30 minutes) more frequently rather than one longer break.

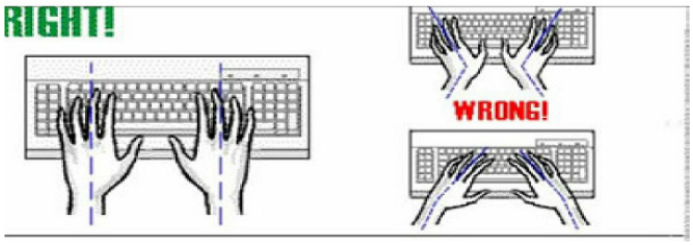
Ergonomic Stretching Exercise for Head and Neck

- Move head sideways from left to right and back to left that isGently lower ear to shoulder and hold for 10 seconds. Repeat on the other side. Do this 5 times. Remember to do this gently and do not jerk your neck.
- Turn head slowly to look over left shoulder and hold for 10 seconds. Repeaton the other side. Do this 5 times
- Chin tucks: Raise the head to straighten the neck. Tuck the chin in and upwards creating a double chin. This also results in a forward tilt of the head. Hold for 10 seconds and repeat 5 times.

3. The KEYBOARD AND MOUSE

- The keyboard's vertical position should be maintained within the recommended range.
- The keyboard and mouse locations should allow you to keep your upper arms and elbows close to body.
- There should be weight bearing support for your arms (chair arms, desktop, or wrist rest) when you are using your keyboard and mouse.
- The keyboard position and angle should allow for a neutral wrist posture so hands are in a straight line with forearms (not bent up/down or sideways toward little finger).

- The tilt of the keyboard may need to be raised or lowered using the keyboard feet to maintain straight, neutral wrist postures while accommodating changes in arm angles.
- Keep the shoulders relaxed, and elbows close to your body.
- Keep elbows are bent to 90 degrees or slightly greater (inner angle)
- Your arms and wrists should rest upon surface areas (chair arms, desktop, or wrist rests) that are absent any sharp or hard edges.
- When typing, your wrists should be in line with your forearms and not bent up, down, or to the side. Your keyboard should be directly centered in front of you. Other frequently used items should be nearby, within arm's reach.
- Avoid extending the wrist while typing.
- Keep the wrists straight while typing.



MOUSE

- Keep the mouse close to your keyboard.
- Drop your arm and hand as one onto the mouse, with your upper arm hanging freely from your shoulder.
- Drape your hand over the mouse, with your palm on the center of the mouse and all of your finger tips hanging over the front and sides (avoid the temptation to grip the mouse with your fingers).
- Make small circular motion with the mouse by making arm movements from the shoulder. Click the mouse button with the mid- section of your finger rather than your fingertip.

Ergonomic Stretching Exercise for Shoulder, arm, and hands.

- **Shoulder rolls:** Circle shoulders forward several times, then backwards. Repeat 3- 5 times.
- **Shoulder sides Stretch:**Stretch arm above head, cradle elbow with hand and pull elbow behind the head. Hold for 10 seconds and repeat 3-5 times
- **Shoulder Arm stretch:** Stand up straight, place your right hand on your left shoulder and move your head left side toward back gently. Do the same thing for the right shoulder. Repeat 3- 5 times
- **Shoulder Arm Swing:** Interlace fingers, palms outwards and straighten arms in front. Hold for 10 seconds and repeat several times.
- Shoulder shrugs: Raise the shoulder towards the ears and hold for 10 seconds and relax downward to a normal position. Repeat 3- 5 times
- **Upper Body stretch:** Interlace the finger and turn palm upward and straighten arms above head. Elongate arms to stretch through upper sides of your rib cage, Hold 10-15 seconds. Breathe deeply.

Ergonomic Stretching Exercise for hand and wrist

- Tightly clench your hand into a fist and release, fanning out the fingers. Repeat 3 times
- Hold hands together in front of your face with elbows outward. Slowly lower hands downward keeping your fingers pressed together. You should feel a stretch from your fingers, into your wrists and up to your elbow. Hold stretch for 20 seconds, relax and repeat.
- With your arm straight out as shown, gently pull your fingers and wrist up ward with other hand. You should feel a gentle stretch from your wrist to your elbow on the lower side of your forearm. Gently pull back on your thumb. You may also benefit from stretching one finger at a time as shown (bottom). Hold each stretch for 20 seconds, relax and repeat.
- With your opposite stabilize all fingers except the one you are exercising. Actively flex (bend) and extend (straighten) the finger at the middle joint 10–15 times. Repeat for each finger individually.

- Slide your thumb across the palm toward the little finger, then wrap your fingers around the thumb. Gently bend wrist downward, you should feel a gentle stretch on the top (extensor tendon) of the thumb and wrist. Hold the stretch for 20 seconds, relax and repeat.
- Place hands on floor (top) or table top (bottom) with fingers pointing backwards toward your body. Gently and slowly lean forward with elbows straight, placing increased weight on your wrist stopper form the stretch. You should feel a gentle stretch from your wrist to the inside of your elbow and forearm. Hold stretch for 20 seconds, relax and repeat.
- Wrist Relief: Hold your arms straight out in front of your body. Raise and lower your hands- bending at the wrist, to stretch the muscles in your forearm. Repeat several times.

4. CHAIR

- The curve of the back fits into the deepest part of the curve in your lower back.
- The back of the chair is upright or tilted back for comfort, and provides upper back supports
- Armrests are adjusted so that they are just slightly below your elbows when your shoulders are relaxed.
- Your knees are slightly lower than your hips.
- There is a 2 to 4 inch gap between the back of your knees and the front edge of the chair when your back is against the chair.
- Your feet are resting comfortably on the floor or on a footrest, and your knees are slightly lower than your hips.
- There should be adequate clearance for your feet, knees, and legs, and enough space to allow you to swivel your chair (without leg obstruction) to perform work tasks.

Ergonomic Stretching Exercise for back

- **Upper back stretch**: Interlace fingers behind head with elbows out Pull shoulder blades together. Hold for 5 seconds and relax.

- **Backstretch:** Sit on chair with feet apart. Gently bend over to stretch the lower back as shown. Hold stretch for 20 seconds, relax and return to an upright position, then repeat the stretch.
- **Back and Hip stretch:** Bend left leg over right leg and look over left shoulder. Place right hand on the left thigh and apply pressure.
- **Repeat for right side:** Sit with knees together. Slowly bend forward and reach to the outside of the right leg with left arm as shown. Hold stretch for 20 seconds, relax and repeat. Then perform stretch on the other side.
- **Hamstring stretch:** Sitting, hold onto upper left leg just above and behind the knee. Gently pull bent knee toward chest. Hold for 15 – 20 seconds. Repeat on right leg.
- **Back and shoulder stretch:** While standing with your feet hold the right hand by left hand behind the back. Gently pull the right hand by left hand and slightly lean the right shoulder towards left side and hold for 10 seconds and relax and repeat to another side.
    1. While standing with your feet about shoulder width apart and with your hands on hips, slowly lean hip forward and shoulder slightly hold for 5 second and relax

<u>The key points to remember are:</u>

- Reduce the load on the back, neck/shoulders and forearms by simultaneously:
    - using your back support on your chair as often as possible
    - keeping your feet firmly placed on the floor
    - having your forearms in contact with your desk (not your wrists only)
- Avoid performing the same repetitive arm movements without taking regular breaks or use different arm motion patterns.
- Avoid more than 1 hour of continuous keyboard use without a rest break for 5-10 minutes.
- Use the ‘micro-pause’ technique – short breaks of 10-20 seconds every 5-10 minutes. In addition, the ‘micro-pause’ should be used to stretch and to look away from the computer screen. Taking regular breaks from the workstation and moving around to improve circulation will significantly reduce risk.
- Avoid sitting in one fixed posture all day.

- Minimize continuous mouse-clicking/mouse scrolling or mouse travel across the desk for long periods without regular breaks and keep the mouse close to your trunk midline.

It is important to think about the task you are performing and adjust your desk, chair, monitor(s) and input devices to enable a comfortable working position.

APPENDIX – VIII

TRAINING CERTIFICATE

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OSHO JEEVAN DHARSHAN YOGA & MEDITATION CENTRE

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Dindigul District, Tamilnadu, India.

ERGONOMICS COURSE CERTIFICATE

This is to certify that ~~Thiru~~/~~Tmt.~~/~~Selvan~~/Selvi. MS. THENNARASI. M of

Place ODDANCHATRAM has successfully taken the "**Ergonomics Course**" held on

DECEMBER

Be blessed with divine power

For THE PRESIDENT
PREM POORNIMA OSHO SILENT FOUNDATION
Oddanchatram, Dindigul (DT), Tamilnadu

APPENDIX- IX

PHOTOGRAPHS

Researcher Collects Data from Subjects by self administered method

Researcher demonstrates Ergonomics to the Subjects